ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA

FEASIBILITY STUDY

US Army Corps
of Engineers
MISSISSIPPI RIVER COMMISSION
New Orleans District

JANUARY 1982

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SOCIAL AND CULTURAL RESOURCES

E.0.1. This appendix presents the social and cultural resources aspects of the project-affected area in two distinct parts. Part I, sections 1 and 2, presents the components of the Other Social Effects (OSE) account and addresses the respective impacts of each alternative upon those components which are significant to the study area.

E.0.2. Part II of this appendix, sections 3 through 12, consists of the study's cultural resource reconnaissance report. A cultural resource reconnaissance is defined as:

> A literature search and records review plus an on-the-ground surface examination of selected portions of the area to be affected, adequate to assess the general nature of the resources probably present and the probable impact of alternative plans under consideration. For archeological reconnaissance, test excavations may be required at some sites so that evaluations may be adequately accomplished. This level of investigation is appropriate to preliminary planning decisions and will be of assistance in determining viable alternative plans.

E.0.3. A reconnaissance level analysis was accomplished for the Atchafalaya Basin (Water and Land Resource), Louisiana, study based upon synthesis of previous archeological and ethnographic investigations in the basin. The main reference for this analysis was the draft report entitled, "Archeology and Ethnology on the Edges of the Atchafalaya Basin, South Central Louisiana: A Cultural Resources Survey of the Atchafalaya Protection Levees," prepared by the University of Southwestern Louisiana, under contract to the US Army Corps of Engineers, New Orleans, District (Gibson et al., 1980). Part II, sections 3, 4, 5, and 6 of this appendix are largely excerpted from the above referenced report.

E.0.4. Based upon existing data, significant cultural resource categories in the study area were defined. The effect of each alternative upon each significant resource was then assessed relative to the base condition and the projected future without-project condition. Finally, the future cultural resource requirements for the project, and the interpretive potential of the basin's cultural resources are discussed.

PART 1 - SOCIAL

Section 1 - SOCIAL RESOURCES

GENERAL

E.1.1. This section of the appendix presents the components of the Other Social Effects (OSE) account and discusses in general terms those components which are significant to the project area communities and/or those for which project-induced changes are of significance to the study area population. A detailed comparison of alternatives and their respective impacts follow this section.

COMPONENTS OF THE OSE ACCOUNT

E.1.2. The components of the OSE account include the following: urban and community factors; life, health, and safety factors; displacement; long-term productivity; and energy requirements and energy conservation.

E.1.3. The principal features of urban and community characteristics are: income distribution, especially the share received by low income households; employment distribution, particularly with respect to minorities; population distribution and composition; the fiscal condition of the state and local governments; and, the quality of community life.

E.1.4. Life, health, and safety factors include such items as: risk of flood, drought, or other disaster; potential loss of life, property, and essential public services due to structural failure; and other environmental effects such as changes in air or water quality not reported in the National Economic Development (NED) or Environmental Quality (EQ) accounts.

E.1.5. Displacement includes the displacement of people, businesses, and farms.

E.1.6. Long-term productivity effects include maintenance and enhancement of the productivity of renewable resources, such as agricultural lands, for use by future generations.

E.1.7. Energy requirements and energy conservation include such items as use of nonrenewable energy resources during construction and operation of facilities, and conservation of nonrenewable resources.

SIGNIFICANT COMPONENTS

E.1.8. Those components of the OSE account containing features that are significant to the study area communities in and of themselves, and also with respect to the alternative plans under consideration are: the urban and community component; the life, health, and safety component; and long-term productivity. The displacement component of the OSE account is significant with respect to alternative plan impacts, but in general, displacement is not significantly more important to study area communities than nonstudy area communities. Energy-related factors included in the OSE account are not significantly more important in the study area as compared to communities in general, nor are any of the project features deemed to have significance with respect to this component.

E.1.9. Urban and Community. Of the principal features that compose the urban and community component of the OSE account, only quality of life as reflected by community cohesion has significance for study area communities in terms of plan alternative impacts as well as in a general sense irrespective of these impacts. The significance of community cohesion, apart from alternative impacts, lies in the unique cultural heritage of the Atchafalaya Basin with its associated ethnic groups and traditional lifestyles. Alternative plan impacts are significant because of the differential impacts on the fish-and-wildlife-supporting habitat that the traditional lifestyles depend on.

E.1.10. Noise is an aspect of the quality of life that is significant with respect to alternative impacts. Due to the semiwilderness nature of much of the study area, plan alternative increases in noise levels would be a significant impact.

E.1.11. There are other features of the urban and community component of the OSE account that would be of at least limited significance to study area communities as a result of plan alternative impacts. These are employment distribution and population distribution.

E.1.12. Employment distribution, in terms of shifts in the distribution of available employment opportunities, would be affected to some degree by alternative plan impacts.

E.1.13. Population distribution, with respect to geographic distribution and density, would be impacted in a limited manner to the degree that plan alternatives differ in their effects on community growth.

E.1.14. The fiscal condition of state and local governments would be impacted to a minor degree primarily as a result of differential plan alternative rates of forestland to cropland conversion and the associated potential changes in the tax base and tax revenues.

Section 2 - ALTERNATIVE PLAN IMPACTS

GENERAL

E.2.1. Social impacts likely to occur under the several alternatives analyzed are evaluated in this section. Nine major categories of impacts have been identified and the impact of each alternative is discussed in terms of effects in each of those categories. These categories are:

- o Community cohesion
- o Noise
- o Employment/Labor force
- o Community growth
- o Local government finance, tax revenue, and property values
- o Health, safety, and security of life
- o Emergency preparedness
- o Displacement of people
- o Displacement of farms.

E.2.2 Community Cohesion. The unique cultural heritage of the Atchafalaya Basin is in large measure linked directly to a way of life based on swamp resource exploitation. The preservation of this traditional lifestyle and the continued existence of some ethnic groups and folk society are dependent on preservation of the swamp habitat.

E.2.3. Under future without-project conditions, there would be a loss of the habitat necessary to provide the occupations that support the traditional lifestyle. The lower floodway would become drier and with the conversion of forestland to cropland, it would become increasingly more difficult to preserve traditional lifestyles.

E.2.4. The impacts of The National Economic Development (NED) plan are essentially the same as would occur under the without-project condition, except that the Avoca Island levee would benefit community cohesion in the backwater area. The Avoca Island levee extension would aid in preserving the existing community life and traditional lifestyles, which would be disrupted if rising water levels, such as would occur under future without-project conditions, forced displacement of these communities.

E.2.5. The Environmental Quality (EQ) plan would reduce the drying-out process and subsequent agricultural development of the lower floodway compared to the future without-project conditions and would result in less loss of fishing and trapping habitat. This would help to preserve the traditional lifestyle of the area. There are, however, features of this plan that may unfavorably impact community cohesion. The public access to large areas of the lower floodways, made available by the environmental easements and recreation features of the plan, could possibly create a conflict between commercial and sport fishermen. Expanded activities by sport fishermen may be viewed as encroachment into the "territorial claims" of the commercial fishermen. Increased public access may also disrupt the traditional patterns and habits of the numerous private hunting clubs in the lower floodway.

E.2.6. The Tentatively Selected (TS) and recommended plans' impacts would be the same as those of the EQ plan.

E.2.7. Noise. The study area, because of the semiwilderness nature of much of it, is a relatively noise-free environment. Few areas, however, are totally noise-free. The activities of the oil and gas industry, water-based shipping industry, and sport and commerical fishermen occur throughout the area. Much of the noise that does occur is due to boat traffic originating with these groups. At times, even in the most remote parts of the basin, noise levels are high.

E.2.8. Under the future without-project condition, noise levels would temporarily rise during levee raising. Noise levels also would increase as agricultural and oil and gas development multiplies. Noise assoicated with recreational and commercial fishing would decrease.

E.2.9. Under the NED plan, noise would significantly increase above future without-project levels. This would be brought about by initial project construction activity as well as to the increased recreational usage and industrial and agricultural development that would follow the construction phase of this plan. Continuing expansion of agricultural and industrial development during the 2030 to 2080 period would continue to increase noise above future without-project levels.

E.2.10. The EQ plan would increase noise levels within the lower floodway and in the area south of Morgan City during the initial construction phase of the project. Following completion of initial construction, noise levels in the southernmost parts of the project-affected area would continue to be higher than in the future without-project condition due to the increased recreational usage of the area that would occur with this plan. In the northern parts of the floodway, noise levels would probably be lower than under future without-project conditions, since the future without-project condition would include the noise associated with agricultural development. From 2030 to 2080, noise levels would continue to be higher than under future without-project conditions in the south of the floodway and lower in the northern portion of the lower floodway.

E.2.11. Noise levels with the TS and Recommended plans would not differ significantly from those of the EQ plan, except during the initial construction phase when they would be slightly higher in the areas south of Morgan City due to the dredging activities associated with channel training the lower Atchafalaya River and Wax Lake Outlet.

E.2.12. Employment/Labor Force. In the 19-parish economic study area, employment in 1970 was concentrated in trade, services, manufacturing, government, construction, agriculture, forestry, fisheries, and mining. Economic area employment was more concentrated in agriculture, forestry, fisheries, and mining in 1970 relative to comparable statewide data. About 24.1 percent of the economic area civilian labor force was employed in these industry sectors while the statewide average was about 15.6 percent.

E.2.13. Under future without-project conditions, there would be a minor increase in employment resulting from raising the east and west protection levees. There also would be some small increase in agricultural employment as forestland became converted to cropland as well as a small increase resulting from the development of water-based industry located on the higher grounds to the south of Krotz Springs. Commercial fishing employment would decrease because the habitat necessary for fish populations would be lost. There could also be a loss of jobs in the manufacturing sector if rising water levels in the backwater area force portions of the Morgan City industrial complex to relocate.

E.2.14. With the NED plan, there would be additional employment opportunities of a minor degree generated by construction of the various structural features of this plan. There would also be additional employment opportunities resulting from the increased visitation generated by the recreation development features of this plan. In the backwater area, the Avoca Island levee extension would help maintain existing employment opportunities, which could be lost due to abandonment of industrial and other commercial activities resulting under future without-project conditions. Within the lower floodway, impacts would be similar to the future without-project condition. There would be some small increase in agricultural employment as forestland was converted to cropland, and commercial fishing employment would decrease as the habitat necessary for fish populations would be lost; however, there would be no increase in employment resulting from the development of water-based industry due to the NED's restriction on structural development.

E.2.15. With the EQ plan, additional employment opportunities generated by construction of structural features and increased visitations of the recreation development feature would be similar to the NED plan. The EQ plan, like the NED plan, would restrict the development of water-based industry in the lower floodway and preclude employment opportunities in this sector. However, unlike the NED plan, lower floodway environmental easements and management unit features of this plan would help maintain existing employment opportunities in commercial fishing and the timber industry, but would restrict potential opportunities in agriculture. In the backwater area, employment in the manufacturing sector would be threatened by rising water levels which might induce relocation. The threat associated with the EQ plan would not be as great as that with the future without-project condition.

E.2.16. The TS and Recommended plans' impacts would be the same as the EQ plan.

E.2.17. Community Growth. The potential for community growth exists in the Morgan City and vicinity area. This growth, the same as business and industrial growth, is directly linked to continued viability and expansion of the Morgan City oil- and gas-related industrial complex. Under future without-project conditions, rising water levels in the backwater area could adversely affect the expansion and even the existence of some facilities, thereby retarding the growth of the area.

E.2.18. Under the future without-project conditions, the most significant influence on community growth would be the negative effect resulting from rising stages in the backwater area.

E.2.19. Within the floodway, residential growth that might occur would be prevented with the NED plan due to restrictions on structural development. In the backwater area, the growth potential of those communities would be preserved due to absence of the higher flood hazard.

E.2.20. The EQ plan would be similar to the future without-project condition in the backwater area. The threat to the Morgan City industrial complex, however, would be somewhat less than the future without-project condition as some plan features act to limit the rise in stages and the corresponding flood hazard. Within the floodway, impacts would be the same as with the NED plan.

E.2.21. The TS and Recommended plans' impacts would be the same as those of the EQ plan.

E.2.22. Local Government Finance, Tax Revenue and Property Values.

The area of local government finance is concerned with items such as the tax base, property values, and tax revenues. Each of these, and other items, are important because they impact the financial condition of local governmental units. Financial soundness is important because it often determines the level and quality of the necessary public services provided by local governments.

E.2.23. Under the future without-project condition, there probably would be a slight increase in property values on forestland converted to cropland and a corresponding potential for increase in property tax revenue. The development of water-based industry in the lower floodway also could result in an increase in local property tax revenue due to these lands being assessed and taxed at a higher rate. On the other hand, rising water levels in the backwater area could force the relocation of industrial facilities and thereby reduce the tax base and tax revenues.

E.2.24. As a result of conversion of forestland to agricultural land and a possible expansion of other forms of development in the backwater area northeast of Morgan City, the NED plan could increase local property tax revenues due to these properties being assessed and taxed at a higher rate than would occur under future without-project conditions. Additionally, the recreational development features of this plan would increase use of the lower floodway, thereby generating increase in sales and other taxes. In the lower floodway there would be only a slight increase in the amount of forestland converted to cropland when compared to the future without-project condition. The difference in the effect on tax revenues would, therefore, also be slight. Restrictions on the construction of structures in the lower floodway would preclude the development of water-based industry and perhaps reduce the tax base and tax revenues as compared to the future without-project condition for this item.

E.2.25. With the EQ plan, impacts to industrial facilities in the backwater area would be similar to but less severe than the future without-project condition as rising water levels threaten relocation of the tax base. The environmental easements of this plan, however, would preclude agricultural expansion in the floodway and would prevent the generation of additional tax revenues above what would occur under future without-project conditions in that area. Impacts on tax revenues resulting from the recreation development features and restrictions precluding the development of water-based industry would be the same as the NED plan.

E.2.26. The TS and Recommended plans' impacts would be the same as those of the EQ plan.

E.2.27. Health, Safety, and Security of Life. In 1927, a huge flood devastated much of the lower Mississippi River Valley. As a result, Congress passed the Flood Control Act of 1928, authorizing the

Mississippi River and Tributaries project to provide for the safe passage of a project flood of 3 million cubic feet per second (cfs) at the latitude of Old River. Because of its early history as a natural floodway, the Atchafalaya Basin became an integral feature of that project with its natural features supplemented by man-made levees, a channel to assist in obtaining the floodway's assigned flood-carrying capacity of 1.5 million cfs, and two outlets for passing the flood waters out of the floodway system to the Gulf of Mexico. At present, the Atchafalaya Basin Floodway system is inadequate and can safely pass only 850,000 cfs, about 60 percent of its assigned capacity.

E.2.28. Under future without-project conditions, flood-carrying capacity would be maintained by raising the east and west protection levees. Levee raising would provide the capability of safely passing the design flood. However, rising water levels in the backwater area would produce adverse impacts to the residents of that area. The data that follow (Table E-2-1) show that there would be significant increases in the number of inundated residents for all frequency events.

E.2.29. The NED plan safely passes the design flood and prevents rising backwater area stages by extending the Avoca Island levee, thereby generating positive impacts.

E.2.30. EQ plan impacts would be the same as those of the NED plan with respect to safe passage of the design flood. However, water levels in the backwater area would increase and generate negative impacts but to a lesser degree than the future without-project condition.

E.2.31. The TS and Recommended plans' impacts would be the same as for the EQ plan.

E.2.32. Emergency Preparedness. As discussed under Health, Safety, and Security, the Atchafalaya floodway and levees comprise a vital part of the regional flood control system, thereby forming a major component of the region's emergency preparedness status. At present, the Atchafalaya Basin system is capable of handling only about 60 percent of its assigned capacity of 1.5 million cfs.

E.2.33. Under the future without-project condition, the floodway would be able to pass a major flood but delays in its use could be engendered by expanded development in the floodway.

E.2.34. NED plan impacts would be similar to the future without-project conditions. However, delays in floodway operation would be somewhat reduced when compared to future without-project conditions due to the restrictions on structural development.

E.2.35. With the EQ plan, the floodway would be able to pass major floods and restrictions of development would insure that few delays in putting it into operation would occur.

TABLE E-2-1

BACKWATER AREA POPLUATION INUNDATED
BY SELECTED FREQUENCY EVENTS

Existing Conditions (1980)

Event Frequency (Years)	Population
5	100
10	100
25	100
50	1,300
75	2,500
100	3,400

Without-Project Conditions (2030)

Event Frequency (Years)	Population 1/
5	3,400
10	3,600
25	14,800
50	15,100
75	15,100
100	16,400

EQ, TS, and Recommended Plans (2030)

Event Frequency (Years)	Population 1/
5	2,500
10	3,600
25	3,600
50	3,600
75	3,600
100	15,700

1/ Affected population in 2030 is based on existing population levels.

E.2.36. The TS and Recommended plans' impacts would be the same as for the EQ plan.

E.2.37. Displacement of People. Alternative plan impacts as they relate to the displacement of people are concerned with the direct and indirect consequences of plan implementation on areas of existing habitation. An example of a direct plan impact is displacement of persons forced to move because they inhabit lands required for project construction. An example of an indirect impact is displacement of individuals induced to move as a result of altered flood conditions caused by plan implementation. Under future without-project conditions, displacement of people would increase from both direct and indirect consequences.

E.2.38. Under the future without-project condition, displacement would occur adjacent to the existing levees as a result of levee raising, and possibly to residents of the backwater area who would experience increased flood hazards.

E.2.39. The NED plan would cause considerable displacement of people and consequent relocations. This would come about primarily due to raising of the east and west guide levees during the first part of project life. This work, which is partially complete and which would also occur under future without-project conditions, would impact hundreds of additional structures located primarily in the Henderson Lake and Courtableau areas. Many of these structures are residential and would involve relocation. Additional displacement of people could occur due to realinement of distributary channels and to widening the Wax Lake Outlet overbank area. It should be noted that this plan would prevent the displacement and relocation of people in the backwater area northeast of Morgan City, which could occur under future without-project conditions due to rising water levels in that area. As many as several thousand people could be benefited by the water level stabilization, which would be brought about by the Avoca Island levee.

E.2.40. The impacts of the EQ plan would be the same as those of the NED plan with respect to construction related displacements. Displacement in the backwater area, however, would be similar to the future without-project condition but not as severe.

E.2.41. The TS and Recommended plans' impacts would be the same as for the EQ plan.

E.2.42. Displacement of Farms. Displacement of farms refers to the forced abandonment of existing farms due to the completion of project features or conditions. Under future without-project conditions, some displacement of farms in the backwater area northeast of Morgan City would occur due to rising water levels associated with enlargement of the Atchafalaya delta.

E.2.43. Under future without-project condition, rising stages in the backwater area northeast of Morgan City would force approximately 10,000 acres of existing cropland out of production. It should be noted that because protection in the form of small levees and pumps will be feasible for some acres, the actual loss will be less than the estimated 10,000 acres which represents the worse-case situation.

E.2.44. The NED plan incorporates the Avoca Island levee extension, which would provide lower stages in the backwater area compared to future without-project conditions. This extension would help prevent approximately 10,000 acres currently used primarily for growing sugarcane from going out of production due to rising water levels in the future.

E.2.45. The impacts associated with the EQ, TS, and Recommended plans would be the same as the future without-project condition.

PART 2 - CULTURAL

Section 3 - ARCHEOLOGICAL INVESTIGATIONS

E.3.1. Possibly, the earliest report of archeological deposits in the Atchafalaya Basin was offered by the surveyor and cartographer William Darby. In his "Geographical Description of the State of Louisiana," he cites several "little mounts" 12 feet taller than the surrounding terrain along Bayou Fusillier (Darby, 1816). Soon thereafter, while appraising timber resources for naval stores, agent James Leander Cathcart described a shell midden near Morgan City "...which bounds an Indian burial ground, from whence they they frequently dig human bones, and once they found a whole skeleton..." (Pritchart et al., 1945). In 1847, an anonymous writer published, in DeBow's Review, his description of a mound and a shell midden along Bayou Pigeon, near Grand Lake. This site was said to be 100 yards in length and to contain human bones (Anonymous, 1847). The geologist and paleontologist John Wells Foster, whose observations on the archeological record of the time were published in a book, noted references to sites in the study area. In referring to a shell midden in the Grand Lake area, he remarked upon a stone ax and a pottery vessel found at that site (Foster, 1873).

E.3.2. During the last quarter of the nineteenth century, personnel of the US Army Corps of Engineers mapped the major drainage systems in the Atchafalaya Basin and on several maps, prepared under the direction of Major C. W. Howell, Indian mounds are demarcated. The sites are near Butte LaRose and along Bayou Sorrel (Howell, 1880-1881). The latter site is also shown on a map entitled, "Hardee's New Geographical, Historical and Statistical Official Map of Louisiana," dated 1895.

E.3.3. The first person to explore the Atchafalaya River with the expressed purpose of exploring archeological sites was Clarence Bloomfield Moore, of the Academy of Natural Sciences of Philadelphia. In 1912 and 1913, he visited and/or conducted tests at 12 sites in St. Landry, Pointe Coupee, Assumption, Iberville, St. Martin, and Iberia Parishes (Moore, 1913). High water at the time of his visit prevented large-scale excavations in the study area. It is notable, however, that "...16 skulls and a few bones..." collected from the Bayou Sorrel site comprise the first prehistoric, human skeletal material from Louisiana to be examined and the analyses published upon by a professional physical anthropologist (Hrdlicka, 1913).

E.3.4. Almost 25 years would pass before any other archeological investigations were conducted in the Atchafalaya Basin. Then in 1937, Fred B. Kniffen, a cultural geographer at Louisiana State University, attempted to document all known sites in Iberville Parish. Through archival research and a field survey he located approximately 18 sites, some of which were in the limits of the present study area (Kniffen, 1938). His was the first attempt, and a most successful one, to note the physiographic implications of observable, archeological deposits in the basin. For one example, the lack of sites directly along the Atchafalaya River was attributed to the speculation that the main channel was too young to have been occupied by prehistoric population in this region. The same reason applies to the area just north of Grand Lake. Using mutually the evidence provided by rangia and unio shells, physiographic relationships and artifact collections, Kniffen (1938) was the first investigator to suggest a relative chronology for the archeological sites in the region under study.

E.3.5. From the 1930s to 1950s, archeological investigations in the Atchafalaya Basin proper were characterized by sporadic visits to previously recorded sites and documentation of a limited number of new sites. The only exception to this characterization is the work of William G. McIntire, a geomorphologist at Louisiana State University. During the 1950s, he visited and supplemented previous collections from known sites in the basin, as well as adding new sites to the record. McIntire's primary aim was to investigate the physiographic phenomena involved in changing stream patterns in the deltaic plain. With the realization that archeological data may be utilized to assist in understanding the history of geological events, he sought out and recorded data from a significant number of sites in the basin, particularly in the lower Atchafalaya region (McIntire, 1958).

E.3.6. In more recent history, several survey efforts within the study area have been conducted. In 1972, an archeological survey, which included parts of the present project area, was conducted on Bayou Boeuf and Bayou Black (Byrd, 1972). This study, performed under a Federal contract, produced an inventory of seven sites in the area.

E.3.7. Under US Army Corps of Engineers sponsorship, Louisiana State University (Neuman and Servello, 1976), conducted an extensive preliminary survey of a large portion of the Atchafalaya Basin in 1974-1976, though this did not include southern portions around Morgan City. A total of 133 archeological sites were recorded. Sites were classified by type and by cultural period; significance determinations and recommendations were made. However, the general utility of the survey was lessened by the absence of material cultural inventories and analyses and by the lack of any attempts at interpretation.

E.3.8. A cultural resources survey of the Gulf Intracoastal Waterway, which bisects the study area near Morgan City, was conducted by Coastal Environments, Inc., in 1975 (Gagliano, Weinstein, and Burden, 1975). This survey included a small part of the present project area.

E.3.9. The same firm and authors also prepared a report in 1978 on the proposed relocation route of US Highway 90, which included areas within the basin. Twenty-nine sites were located and assessed as to eligibility to the National Register of Historic Places.

E.3.10. In 1978, the University of Southwestern Louisiana conducted a survey of the lower Atchafalaya region in the parishes of Ascension, St. Mary, and Terrebonne under contract to the US Army Corps of Engineers, New Orleans District. The survey was limited to narrow linear corridors along Bayous Chene, Shaffer, Avoca Island Cutoff and, additionally, to an overland route along the Avoca Island Outlet channel. It was performed to provide a substantive basis for making recommendations for the avoidance of adverse impacts of planned construction on significant cultural resources. A total of 39 historic and prehistoric sites were found within project corridors.

E.3.11. An overview of the existing archeological data in the Atchafalaya Basin was prepared by Dr. Jon Gibson of the University of Southwestern Louisiana in 1979, under contract to the US Army Corps of Engineers (Gibson, 1979). Major archeological problems and suggested research strategies were offered.

E.3.12. The University of Southwestern Louisiana also conducted a survey, again under contract to the Corps of Engineers, of the East and West Atchafalaya Protection Levees in 1980 (Gibson et al., 1980). This survey was aimed at assessing the significance of cultural resources in the project corridors. Thirty-three sites were examined and 12 of these were judged to be significant and eligible for inclusion in the National Register of Historic Places.

E.3.13. In summary, archeological surveys in the Atchafalaya Basin have resulted in the discovery of hundreds of sites. To date, these surveys have been relatively few in the study area. Additionally, thorough on-the-ground search of certain localities is not a 100-percent sure method of discovering all or even most archeological sites. No evaluatory program has been tried that would yield the representativeness of the site sample compared with the number of sites (e.g., buried by alluviation, etc.) really present. Because many of the surveys were guided by aims other than the production of site distributional information, they have not resulted in archeologically useful data on siteless (or presumed siteless) areas, a necessity to analyses of spatial distributions. The site distribution pattern in the Atchafalaya Basin is a pattern produced by intensive efforts in a few corridors, preconceived assumptions by investigators, and the masking of the terrain by geomorphic activity. It is not a pattern that truly reflects the dispersion of archeological sites and should not be regarded as such.

Section 4 - PREHISTORY OVERVIEW

GENERAL

E.4.1. Over 250 prehistoric and historic archeological sites are recorded within the basin. This number is based upon review of site map files of the Louisiana Division of Archeology and Historic Preservation and files of the US Army Corps of Engineers, New Orleans District. The recorded prehistoric sites range from small midden deposits to large ceremonial mound centers.

E.4.2. The archeological sequence for southeastern Louisiana in which archeological manifestations exist is generally organized into six major units. A summary of these divisions is offered below. (Modified from Neuman, 1976.)

E.4.3. Paleo-Indian, 10,000 B.C. - 6,000 B.C. Diagnostic traits include bifacially chipped, lanceolate projectile points, both with and without flutes, extending up from a straight or concave base, along the longitudinal axis of the points.

E.4.4. Subsistence economy was based on hunting and gathering. Excavated sites reveal artifacts in association with terminal Pleistocene megafauna.

E.4.5. The settlement pattern revealed in archeological deposits generally consists of small temporary campsites near or along the edges of springs.

E.4.6. Archaic, 6,000 B.C. - c. 500 B.C. Diagnostic traits include a greatly expanded chipped stone and ground stone inventory, common throughout the Archaic, and includes medium to large-stemmed, triangular projectile points, side and end scrappers, perforators and drills, bifacial "knives", ground stone beads, celts, plummets, steatite vessels and effigies. Clay figurines and shell ornaments, an expanded bone industry that includes antler atlatl hooks and bone awls, a wide range of baked clay objects, and the importation of exotic raw stone material were added by the terminal Archaic Poverty Point culture group.

E.4.7. Subsistence economy consisted of hunting, gathering, and collecting, and there exists no physical evidence of a cultivated or domesticated food base.

E.4.8. Settlement pattern of this period includes large earthworks at the Poverty Point site, West Carroll Parish, comprised of a mound and concentric semi-circular ridges. A low-domed, earthern tumulus was tested on Avery Island; also, several campsite deposits of this period were examined in the Lake Pontchartrain area. A series of seven, low earthen mounds built in a circular pattern is known as the Pickett Island site, Catahoula Parish. At the Monte Sano Site, East Baton Rouge Parish, excavations revealed remains of a structure having a square floor pattern. An earthen midden located on an inset terrace remnant is present to the west of the Atchafalaya Basin in St. Landry Parish.

E.4.9. Tchefuncte, c. 550 B.C. - A.D. 250. Diagnostic traits of this period include the first major introduction of pottery. Vessels are conical with multi-form, tetrapodal bases. Incised, brushed, punctated, and stamped decorative motifs appear on the vessel bodies and rim exteriors. A thick, red slip is present on some plain vessels. Decorated tubular, clay pipes are also introduced. Chipped and ground stone, bone and shell implements, and baked clay objects are common. These forms are similar to those of the terminal Archaic period but are generally less plentiful, variable, or ornate.

E.4.10. Subsistence economy during this period consisted of hunting, gathering, and collecting, with a probable trend toward broad-spectrum subsistence pursuits, which include a cultivated and possibly domesticated food base. Indications exist of horticulture from Tchefuncte deposits at the Mortin Shell Mound, Iberia Parish, and the Bayou Jasmine site, St. John the Baptist Parish.

E.4.11. Settlement patterns exhibited during this period consist of numerous sites in the marsh areas of southern Louisiana that are characterized as shell and organic middens. Inland sites most numerous along the prairie terrace to the west of the Atchafalaya Basin (Teche-Vermilion Watershed) principally consist of small, low, earthen mounds and middens. Gibson (1980) has confirmed Tchefuncte presence in the basin at several sites, including 16IV4 (Bayou Sorrel Mounds).

E.4.12. Marksville, A.D. 250 - A.D. 700. Diagnostic traits of this culture period are new pottery types comprised of bowls and globular, jar-shaped vessels that are elaborately decorated on the exterior with punctated, incised, and stamped motifs. Vessels may also be decorated with red pigment and stylized zoomorphic motifs. Ground stone and ceramic platform pipes and effigies are present. Artifacts of exotic raw materials, including copper, quartz crystals, asphaltum, and galena, are often present in sites of this period.

E.4.13. Subsistence economy of this period included broad-spectrum hunting and collecting augmented by a probable domesticated food base. Corn and squash are purported from the Marksville site, Avoyelles Parish.

E.4.14. Settlement pattern is somewhat varied; one extensive occupation, the Marksville site, consists of a group of earthen mounds within a semi-circular, ridged, earthen wall. Domed mounds contain a central chamber for the disposal of the dead. Human interments, both primary and secondary, are deposited along with a selected quantity of pottery, chipped and ground stone, bone, shell, and copper funerary offerings. Other sites consist of middens and/or mounds with no visible evidence of palisades or enclosure. Evidence of a possible habitation structure, rectangular in plan with a semi-subterranean floor, was exposed at the Marksville site.

E.4.15. Troyville-Coles Creek, A.D. 700 A.D. - c. 1100. Diagnostic traits include the introduction of clay as a ceramic tempering agent, also the development of new decorative designs and vessel shapes is characteristic of this period. Simple incising on a wide variety of rims marks the earlier forms, while incising, punctating, and check--stamping become dominant later. This period is also marked by an expansion in bowl and platter (plate) vessel shapes. Elbow-shaped clay pipes, ear spools, and grinding stones become important features. Toward the end of this period, the preponderance of small, finely chipped projectile points probably indicated the introduction of the bow and arrow, whereas previously the atlatl predominated.

E.4.16. Based upon corn and squash agriculture, the subsistence pursuits were supplemented by broad-spectrum hunting and gathering.

E.4.17. The settlement pattern is characteristically, three large pyramidal, compound mounds oriented around an open plaza. Houses have either rectangular or oval floor patterns. Mounds of the Troyville site, Catahoula Parish, were within a large rectangular ditch (moat) and earthen enclosure. Multiple primary and secondary human interments, generally without artifactual associations, are common features in the mounds.

E.4.18. Plaquemine - Mississippian, A.D. 1100 - A.D. 1700. Diagnostic traits include new ceramic typologies, shell-tempered pottery, effigy vessels, new decorative motifs, strap handles, effigy pipes, and ear spools which characterize this period. Complicated stamped designs are presented during the earlier phases, with curvilinear design predominating later. Late in the period, native artifacts are found in association with European trade goods. "Southern Cult" artifacts are also present in some sites.

E.4.19. The subsistence economy was based on corn, bean, and squash agriculture supplemented by seasonal hunting and collecting.

E.4.20. The settlement pattern, consisting of large, compound, pyramidal mounds oriented around an open plaza, is characteristic of the larger sites. Mounds may have stepped ramps. Round, rectangular, or square structure floor patterns occur, with or without wall trenches. Some villages are surrounded by wooden palisades.

Secondary single and multiple-bundle burials occur in the mounds. Primary, flexed, human interments are also present.

E.4.21. The preceding categories are generalizations of cultures and types of sites to be found in the Atchafalaya Basin. The number of previous archeological investigations within and near the Atchafalaya Basin give the impression that the prehistory of the great swamp is well known. This is not the case. To describe the archeology of the basin requires the imposition of culture sequences that originated in regions outside the basin and the adoption of several corresponding assumptions about culture processes.

E.4.22. When Indians first moved into the Atchafalaya Basin is a matter of considerable conjecture.

E.4.23. No residues from Paleo-Indian activities are known within the present-day Atchafalaya Basin. Yet does this imply their absence or merely that the land surfaces that might have borne these evidences have been eliminated or buried by river channel shifts since Paleo-Indian times? Characteristic Paleo-Indian artifacts, mainly projectile points, have been found on Godeau Hill and Evergreen Island on the western edge of the modern Atchafalaya Basin. They seem to be associated with a relict, resculptured Mississippi River meander belt (i.e., the Lafayette-Mississippi meander belt), which has been entirely obliterated from the contemporary surface of the Atchafalaya Basin.

E.4.24. A similar conclusion can be reached concerning Archaic components. Although Archaic sites have been identified in the upper part of the basin, they all seem to lie along older, elevated landforms that have remained relatively untouched by subsequent degradation within the swamp itself. One such component is site number 16AV33. Superficially, 16AV33 appears to be connected with the Bayou Jack segment of the Teche-Mississippi course, which Saucier (1974) believes was active about 6000-4000 B.P. However, sediments and soils at the location hint of a far more complicated geomorphic picture, one that may have involved an ancestral meander belt of the Arkansas River. Archaic sites are densely scattered along the exposed natural levees of Big Darbonne Bayou, implying that the bayou was a significant water course during an earlier phase of its existence. Gagliano et al., (1978) suggests that Big Darbonne Bayou may have been a major crevasse.

E.4.25. South of US Highway 190, no Archaic sites have been identified from within the basin proper, although they do parallel the swamp margins atop the Mississippi alluvial valley walls themselves. In other words, they overlook the swamp but seemingly do not extend into it. This may seem somewhat unusual because the Teche-Mississippi River system, which apparently supports Archaic components in the upper reaches of the Atchafalaya Basin, is well preserved to the vicinity of modern-day Berwick and Morgan City.

E.4.26. Until Gibson's (1980) survey of the East-West Atchafalaya Protection Levee, it was believed that Tchefuncte settlements were also missing in the Atchafalaya Basin. Now it is known that they do exist. They appear in high densities along the western edge of the basin flanking the Bayou Jack, Bayou Rouge, and Petite Prairie meander belts. From Bayou Courtableau (US Highway 190) south to Berwick, near the southern end of the swamp, the settlements seem to be more scattered but are present nonetheless. This survey, in fact, confirmed Tchefuncte components on the eastern flank of the Teche Ridge at Bayou Perronet (16SM50), Charenton Beach (16SMY2), and Mocassin (16SMY104). The Lake LaRose Mounds (Moore 1913), in the middle of the swamp about 7.5 miles southeast of Bayou Perronet, may also have a Tchefuncte component. On the eastern perimeter of the basin, Tchefuncte occupation may be present at Bayou Sorrel Mounds (16IV4) and the Schwings Place (Moore 1913). Both of these sites, however, appear to be positioned atop stable, elevated, remnant landforms, presumably formed by early Mississippi River alluviation, perhaps the Maringouin-Mississippi River. By normal archeological criteria, Poverty Point components are difficult to identify in many localities in south central Louisiana. This is probably a function of distance (200-250 miles) from the Poverty Point localities on the Macon Ridge in extreme northeastern Louisiana and western Mississippi, where typological details for culture unit attribution were originally extracted. Population enclaves in south central Louisiana, which were contemporary with the Poverty Point developments upvalley, were simply doing things in their own time-honored, traditional manner, which had proved adaptively successful for them and their ancestors. By stretching typological criteria and emphasizing the presence of exotic trade materials, it is, however, possible to ascribe some Atchafalaya edge components to the Poverty Point culture period. The Stelly mound group on Bayou Petite Prairie, near the Bayou Jack-Bayou Rouge meander complex (Teche-Mississippi meanders belt), seems to be a local center of activities during Poverty Point times. Farther down the valley escarpment in the vicinity of Lafayette, Louisiana, there is another cluster of sites, which temporally and, to an attenuated degree, culturally equate to the Poverty Point culture period. There are similar typological and interpretive problems in dealing with the Marksville, Coles Creek-Troyville and Plaquemine-Mississippian culture periods.

E.4.27. In short, very little is known about substantive prehistory in the Atchafalaya Basin and, in many cases, what is known is not based on findings from the basin proper but from outside regions, so distinctive from the swamp that applicability may be questioned. Almost every aspect of Atchafalaya prehistory is at issue, from chronological segmentation and culture unit systemization to simple descriptive and reconstructive categories dealing with settlement subsistence, and higher-order levels of cultural interest. The state of understanding is so germinal and the technical problems with acquiring representative information so numerous that it cannot be claimed that the Atchafalaya Basin has contributed greatly to the explication of culture change, evolution, and historical events among native American population in the Lower Mississippi Valley.

E.4.28. One thing seems certain. The uniqueness of the region demands unique archeological perceptions and interpretations, and, therefore, great care must be exercised in determining the significance of sites and their disposition.

Section 5 - HISTORY OVERVIEW

GENERAL

E.5.1. Many of the 252 recorded archeological sites in the basin contain historic components. These include possible historic aboriginal remains as well as remains of European settlement in the basin. The considerable number of recorded ship disasters and Civil War-related vessel sinkings indicate the existence of subsurface or underwater ship remains. An overview of recorded history in the basin is provided in the following paragraphs. This overview is largely excerpted from Jon L. Gibson's and Robert B. Grambling's draft report (Gibson et al., 1980).

EFFECTS OF EUROPEAN CONTACT UPON NATIVE SETTLEMENT IN THE BASIN

E.5.2. The Atchafalaya Basin remained for a time off-limits to the terra firma-bound whites, and the few excursions into the swamp were confined to its higher borders. As a matter of fact, it was only after the native residents, the Chitimacha Indians, incurred the wrath of the French, following the assassination of the missionary St. Cosme in 1706, that French marauders, under St. Denis, dared to venture into the swamp's dark confines, and then only along the Fork of the Chitimacha (i.e., Bayou Lafourche) (Iberville in Brasseaux, 1979). However, one suspects that this incident was only an excuse to cover up the real reasons for the declaration of war on the Chitimacha; a more likely motivation being the desire to acquire Indian slaves.

E.5.3. The coming of first the French, then the Spanish, and finally the Americans furnishes several important considerations for the treatment of native settlement. First, it provided written documentation, though scant, of occupant groups and accorded tribal names to them, and it seems to have resulted in an upset of intertribal relations forcing tribal amalgamations, or extinctions, tribal shifts and migrations, and perhaps a general westward retreat across the basin, away from the white-controlled Mississippi River. It also introduced nonindigenous natives, displacing them from their original homes along the Mississippi River, into the lower and upper reaches of the basin. With these European-induced influences, swamp settlement patterns underwent change, ranging from almost negligible in some areas to extensive in others.

E.5.4. An initial effect was the nearly complete withdrawal of Indians from Bayou Lafourche, the so-called Fork of the Chitimacha, the eastern natural boundary of the Atchafalaya Basin. Early records (cf. Swanton, 1911) reveal that stretches along Bayou Lafourche were occupied by the Chitimacha, the Washa, and the Chawasha. The latter two tribes, allies of the French and enemies of the Chitimacha (Swanton, 1911), seem to have merged, or at least become confused, and probably moved to the Mississippi River near New Orleans. After De Kerlerec's mention of them in 1758 (Swanton, 1911), they disappear from recorded history. The Lafourche also seems to have been vacated by the Chitimacha but their fate is unknown. It is possible that they joined or became the Chitimacha group encountered sometime later around Bayou Plaquemine, upstream from the Bayou Lafourche-Mississippi River confluence.

E.5.5. In 1882, Gatschet published the names of 15 Chitimacha villages, supposedly occupied around 1700; locations provided by an old Negro informant living on Grand Lake. Swanton (1911) acquired several more village locations from Benjamin Paul, last hereditary chief of the western Chitimacha in 1908-1909. Perusal of other documentary sources (Gibson, 1978) brings the total of known villages to about 30. Gibson (1978, 1980) has tentatively correlated five of the villages with known archeological sites or with locations of landtracts precisely delimited in conveyance records.

E.5.6. As previously intimated, the Lafourche Chitimacha may have moved northward to Bayou Plaquemine, or they may have simply moved across the Atchafalaya Basin and joined the western branch of the Chitimacha living on the lakes (particularly one called Lake of the Chitmachas, now Grand Lake) and along Bayou Teche.

E.5.7. Another circumstance of consequence to historic native settlement patterns in the Atchafalaya Basin concerns the apparent disappearance of at least two swamp tribes after the time of initial European contract. LaHarpe (in Conrad, 1971) mentions tribe, called Onquilouza, allied with the Washa and Chawasha, during his efforts to bring these tribes under French dominion in 1699. The Onquilouza are never mentioned again. The same literary fate befell another Atchafalaya tribe, variously referred to as Yagueneschito, Magenesito, Yagueneschito and Yaguenechitons (LaHarpe in Conrad, 1971; Iberville in Brasseaux, 1979). Like the Onquilouza, they were simply never mentioned after the Iberville and LaHarpe narratives were written. Swanton (1911) guesses that Yagueneschito might be a reference to the Attakpa and, if this is correct, the subsequent history of this group would have nothing further to do with the Atchafalaya Basin.

E.5.8. The beginning European colonization along the Mississippi River had other direct effects on native settlement in and near the Atchafalaya Basin. Nonindigenous tribes sought refuge in the poorly settled swamp and swamp margins. The Tunica (later amalgamated with the Biloxi) culminated a series of migrations from an original hearth in western Mississippi, opposite the mouth of the Arkansas River, by taking up residence at Coulee de Grues near Marksville, Louisiana, sometime during the latter part of the eighteenth century (Brain, 1977). This location, which actually falls in or very near the old homeland of the liquor-destroyed Vaoyels tribe, lies on the northern perimeter of the basin and is actually outside it.

E.5.9. The Lafourche delta country in Terrebonne Parish, on the southeastern edge of the Atchafalaya swamp, witnessed an influx of another Mississippi River tribe, the Houma. Throughout much of the European contact period, the Houma resided on the east bank of the Mississippi River in the Pointe Coupee vicinity. Following a series of epidemics and apparent foul experiences at the hands of the colonists, they migrated, Swanton (1911) says drifted, into the unoccupied swamps and marshes of Terrebonne Parish, where they live today. In route, they assimilated the decimated remnants of the Bayogoula and Acolopissa tribes, forming an ethnic amalgum. When they moved, or drifted, to this location is uncertain but by the first half of the nineteenth century, their presence in the Terrebonne area was noted (Swanton, 1911). The relocation of the Houma has interesting implications for settlement studies. While at their originial Mississippi location, the Houma were confirmed horticulturalists, resided in relatively large, sedentary villages, and seem to have had strong political and religious systems, and probably a rigid social heirarchy. After less than two centuries of occupation in the swamps and marshes, this group was transformed into hunters, trappers, and fishermen. Horticulture was largely forsaken. Settlement shifted from nucleated villages to extended linear communities along bayou banks. Seasonal extractive activities were adopted with all the evident consequences for year-round settlement instability. Tribal unity dissolved with the increasing autonomy of nuclear family units. The sense of tribalism faded, and today the Houma and their adopted brethern identify largely with being Indian rather than with being Houma (Stanton, 1979).

EARLY EUROPEAN SETTLEMENT PRIOR TO 1803

E.5.10. Early access to and within the basin depended entirely upon water transportation (Stoddard, 1812). There were two main routes across the basin prior to 1803 and both entered the swamp through Bayou Plaquemine, a Mississippi River distributary, on the eastern side of the basin. Passage through Bayou Plaquemine depended upon the level of the Mississippi River, and although the bayou was cleared and dredged in 1770, reliable passage through the basin was available only at high water until recent times (Comeaux, 1972; Robin, 1966). Smaller boats could, however, be tranported over land around the shallow entrance of Bayou Plaquemine. By 1805, a private portage service, complete with log rollers and mules, was operating on a sporadic basis (Prichard, Kniffen, and Brown, 1945).

E.5.11. Early settlement was limited to the periphery of the swamp and occurred entirely along the Teche Ridge. In 1765, Poste des Attakapas (St. Martinville) was established by several hundred Acadian refugees who arrived in Louisiana via Santo Domingo (Rushton, 1979). After Louisiana was ceded to Spain in 1766, a small Spanish settlement was established at New Iberia under the leadership on Don Francisco Bouligny in 1779 (Conrad, 1979). Although never substantial, immigration and settlement continued steadily throughout the Spanish period.

E.5.12. Many of the settlers in Louisiana prior to 1803 were refugees from Acadia (Nova Scotia) and the Creole French who were forced out of Santo Domingo during the slave rebellion (Rushton, 1979). Although some settled in the Teche region, most established themselves along the banks of the Mississippi River at New Orleans and upriver at the so-called Acadian Coast (Taylor, 1976). In 1803, Louisiana was returned to French control but only for 20 days as part of the political maneuver enabling Napoleon to sell the territory to the United States.

GROWTH OF THE PLANTATION SYSTEM, 1803-1861

E.5.13. Immigration began in earnest with the Louisiana Purchase. Between 1803 and 1810, the slave population doubled. Between 1810 and 1820, the entire population of the state doubled again (Rushton, 1979). Throughout the territorial period and early statehood (granted in 1812), population along the natural levees of Bayou Teche grew rapidly.

E.5.14. It was during the early days of the American period that agriculture became quite diversified, and cash crops grew in importance.

E.5.15. In 1819 when James Leander Cathcart undertook a survey of the timber resources of the Atchafalaya Basin, settlement was continuing on the high natural levees of Bayou Boeuf and Bayou Teche, and was beginning in interior sections of the basin, such as Bayou Plaquemine (Prichard, Kniffen, and Brown, 1945).

E.5.16. As settlement continued along the stream levees on the margins of the basin, the growth of commercial agriculture was stymied because of the lack of an effective means to get products to market (primarily New Orleans). The watery nature of the basin practically assured that the primary system of marketing transportation would make use of the natural transportation linkages, the waterways. Virtually all European and Euro-American travel in the basin up to that time had been by boat.

E.5.17. The steamboat, which enabled rapid, efficient, and economical means of water transportation, began to make significant inroads in the southern economy by the first few decades of the nineteenth century. Its impact on the Atchafalaya Basin was enormous and lasting.

E.5.18. Steamboats first reached the Atchafalaya Basin in 1819. The 103-ton Louisianais, constructed in New Orleans, was one of the first. It served primarily as a cattle ferryboat in the lower Atchafalaya Basin. By 1820, the Attakapas Steamboat Company operated the 295-ton Teche between New Iberia and New Orleans via the Gulf of Mexico (Brassaux, 1979). Following the demise of the Attakapas Steamboat Company, Captain Robert Curry brought his 48-ton Louisville through Bayou Plaquemine and the Atchafalaya Basin to Franklin in 1825 (Planter's Banner, 27 April 1848). Smaller steamers used Bayou Plaquemine (and later the improved Attakapas Canal) and the safer interior route to Bayou Teche during periods of high water. Since products were ready for market, steamer traffic took on a decided seasonal emphasis. Larger steamers were restricted to the gulf route, down the Mississippi River from New Orleans, then through the gulf and Atchafalaya River to Bayou Teche. Since the Teche was navigable to New Iberia year round by larger steamers, New Iberia soon became a major land center for water transportation.

E.5.19. Travel aboard antebellum steamboats was dangerous. Teche Valley pilots frequently whiled away their off-duty hours by drinking, and playing cards with the passengers in the bar. Fatigued and often inebriated, the pilots often steered their raft over dangerous shoals and snags. In fact, between 1825 and 1860, at least 19 vessels, 89 lives, and thousands of dollars in goods were lost along the Teche and in the Atchafalaya Basin as a result of mishaps. Oceangoing steamers were not much safer, as they were frequently top-heavy and easy prey to the violent thunderstorms for which the Gulf of Mexico is noted (Conrad, 1979).

E.5.20. Despite seasonal limitations and natural dangers, the steamboat provided the efficient and essential means of transportation from farm to market, which permitted the rapid development of the plantation systems along the margines of the Atchafalaya Basin.

THE PLANTATION SYSTEM IN THE ATCHAFALAYA BASIN

E.5.21. Growth of the plantation system in the Atchafalaya Basin resulted from the wedding of a socioeconomic system born in the southern states east of Louisiana with a locally successful crop, sugar. The familiar ideological bases and means for the plantation system spread westward with the emigration of English-speaking settlers.

E.5.22. Rivers provided the natural transportation and the steamboat was the work-horse for the system. The period of most accelerated development of the plantation system occurred between 1830-1860. Large plantations resulted in the diplacement of the small subsistence farmers and stock-raisers, particularly along the linear stretches of prime land, the natural levees of streams.

E.5.23. In other areas of the South, the plantation system developed around cotton. In southern Louisiana, including the Atchafalaya Basin, the system came to center on the production of sugar. Sugar had been produced on a limited basis in Louisiana since earliest colonial days, and throughout the eighteenth century, rum (tafia), produced from local sugar, was about the only distilled drink available. It was after 1800 that production of sugar became a serious enterprise. By 1835, the transition to sugar was virtually complete, and the sugar plantation began to develop as a social and economic way of life.

E.5.24. By the 1850s, the plantation society was in full bloom in the Atchafalaya Basin area (Sitterson, 1953). The wealthy planters evidenced lifestyles and value systems characteristic of the upper class everywhere, a lifestyle dominated by leisure and recreation, travel, and conspicuous consumption. Yet, with growth came attendant population pressure in settlements, because crowding was not solely an urban problem since most of a plantation workforce tended toward nuclear residence.

E.5.25. One by-product of these crowded conditions and lack of sanitation facilities was the ever-present threat of illness, which in the case of yellow fever and cholera, frequently reached epidemic proportions. In 1833, and again in the winter of 1848-1849, cholera ravaged southern Louisiana, killing thousands (Sitterson, 1953). While such epidemics were not common, cholera remained a problem until the beginning of the twentieth century.

E.5.26. Less common than cholera but more virulent, yellow fever made its appearance in the lower Atchafalaya in 1839, and after the Civil War in 1867 and 1878 (Conrad, 1979). Introduced into Louisiana in the 1790s from the Caribbean, yellow fever decimated nineteenth century urban populations in southern Louisiana. Unaware of the cause of the disease, or the fact that it was spread by the Aedes aegypt mosquito, nineteenth century treatment and preventive techniques did little to control its spread (Conrad, 1979). During the 1867 epidemic, the town of New Iberia, with a popultion of approximately 1,500, had almost 1,000 cases of yellow fever and over 100 deaths occurred (Conrad, 1979). Ironically, the steamboats, which made the plantation way of life feasible, were also responsible for the spread of cholera and yellow fever. The large-scale movement of human populations throughout the area hastened the spread of disease and increased the probability of epidemics. While slaves were more commonly the victims of cholera because of crowding and poor sanitary conditions, the everpresent mosquito made no distinction among social classes. Thus, the period marked by the growth and decline of the plantation-dominated economy in the Atchafalaya Basin area was also noteworthy for loss of life due to illness and disease.

E.5.27. By the middle of the century not only was the Teche Ridge heavily settled, but the plantation system had also spread to the adjacent levees of Bayous Black and Boeuf and to the interior of the basin. The interior of the basin began to be settled as early as the 1840s around Bayou Chene (Comeaux, 1972).

E.5.28. Agriculture also began along Bayous Pigeon and Sorrel and the Grand River by 1845 (Planter's Banner, 17 June 1847). This area was developed primarily by absentee landlords and was heavily dependent on slave labor (Comeaux, 1972). A third area in the interior of the basin where plantation agriculture was practiced was along the natural levees of the Atchafalaya River north of Butte LaRose. This land was settled by 1818 (Darby, 1818), and most of the land spoken for by 1838 (Prichard, 1941). In addition to sugar, cotton was grown during this time period along Bayou Alabama (Comeaux, 1972).

E.5.29. In 1857, the New Orleans, Opelousas and Great Western Railroad was completed from Algiers, on the Mississippi River across from New Orleans, to the Atchafalaya River at Berwick Bay. The railroad, which took five years to complete, was to reorganize transportation and settlement in the basin and also sparked the development of what was to become the Atchafalaya Basin's major urban area, Brashear (later to become Morgan City).

E.5.30. With the completion of the railroad, regular steamboat service from Berwick Bay to Galveston was initiated by the New Orleans, Opelousas and Great Western Company in conjunction with Cornelius Vanderbilt, a national shipping magnate.

E.5.31. The town grew rapidly. Located along a crucial transportation route, its advantages quickly became apparent to would-be settlers. By 1859, there were 40 homes, a Catholic church, and a number of businesses in Brashear. In 1860, the town was officially recognized by the state legislature, and the community looked toward its first experience as a boom town, an experience which was to be delayed by the Civil War (the Morgan City Historical Society, 1960).

THE CIVIL WAR

E.5.32. The strategic importance of the Atchafalaya Basin after the fall of New Orleans and Baton Rouge to Federal forces in May of 1862 was due to Fort Hudson, a Confederate fortification on the Mississippi River north of Baton Rouge. Port Hudson was an obstacle to Federal control of the Mississippi River. Therefore, to open up the Mississippi River for Union troop movements, Union General W. P. Banks in 1862 proposed an alternative route around Port Hudson. This strategy involved driving the Confederate forces under General Taylor out of the Teche region to open routes through the basin and Bayou Teche up to the Mississippi River.

E.5.33. The primary Confederate defenses were constructed at Fort Bisland, straddling Bayou Teche near modern Calumet and Fort Burton on the western bank of the Atchafalaya River at Butte LaRose. In early April 1863, a combined naval and land Union force 18,000 strong attempted a pincer move on Fort Bisland. Heavily out-numbered, the Confederate troops under General Taylor abandoned Fort Bisland and retreated up Bayou Teche, hotly pursued by Banks. The Atchafalaya Basin was now controlled by Union forces and troop movements by water were unopposed. Upon reaching Alexandria, Banks reassessed his pursuit of General Taylor's forces and chose to mount an offensive on Port Hudson. Learning of Bank's troop redeployment and the weakening of Federal strength in Berwick Bay, Confederate General Taylor quickly devised a counter-attack to retake the area. Taylor's strategy to attack Brashear City was executed flawlessly, and the Union forces quickly surrendered on 23 June 1863.

E.5.34. After the fall of Port Hudson and Vicksburg to Union forces, the second Union invasion of the Louisiana bayou country began in September of 1863. General Taylor wisely withdrew his troops from Brashear City and employed hit-and-run strategy on the advancing Union troops. Unable to face Union troops in pitched battle, the constantly moving Confederate cavalry and patrols sniped, raided, and continually harassed the Federal troops.

E.5.35. This invasion, the Great Texas Overland Expedition, was turned back by the hit-and-run strategy of the Confederate forces, the indecisiveness of Union Commanders Banks and Franklin, and the pivotal Battle of Bayou Bourbeaux.

E.5.36. In March of 1864, Banks made on final attempt to push overland to Texas. The Union operation was three-pronged. Admiral Porter, with 19 gunboats and 10,000 men, under the command of General A. J. Smith, was advancing up the Red River. General Steele, with 12,000 men, was moving toward Banks from Camden, Arkansas. And Franklin, with 18,000 men, was advancing northward along the Teche Ridge (Evans, 1899).

E.5.37. Confederate General Taylor, who had been camped at Alexandria, moved on to Mansfield ahead of Porter's fleet. Porter captured Alexandria on 15 March. Steele' Arkansas force was delayed. When Banks arrived in Alexandria, he linked with Smith's 10,000 men and moved on Mansfield. In the ensuing Battle of Mansfield, Taylor's Confederate forces, though out-numbered almost three to one, routed Banks and pursued him south through Alexandria (Evans, 1899). Leaving Alexandria in flames, Banks retreated down Red River road and escaped across the Atchafalaya River at Yellow Bayou. At the Atchafalaya River, Taylor stopped. Although the war would not end until the following summer, General Taylor was later to write (Taylor, 1879): "From the action of Yellow Bayou to the close of the war, not a gun was fired in the trans-Mississippi department."

RECONSTRUCTION AND ECONOMIC REORGANIZATION

E.5.38. The Civil War had several major impacts on the sugar plantation system. First, the war eliminated the primary source of labor, the slaves. With post-war emancipation, blacks who remained in the South had to be hired by planters. Gone forever was the forced, "free" labor under slavery, and the transition to a wage economic structure was neither smooth nor painless. Many a crop in the Lower Atchafalaya Basin was ruined by the breakdown of labor-management relations in the post-war years (Sitterson, 1953).

E.5.39. Another major blow to the sugar industry was the destruction of physical facilities during the three major Union campaigns along the Teche Ridge. Particularly destructive was Banks' first push up the Teche in the spring of 1863 (Raphael, 1975). Fences and buildings were used for firewood, livestock and supplies were consumed and, in many cases, homes and plantation facilities were subjected to destruction and other kinds of extreme vandalism.

E.5.40. A final serious consequence was the war-disrupted financing and marketing structures. Heavily in debt, with plantations in need of extensive repairs, credit destroyed and with little ready cash in hand or available from lending institutions, many formerly wealthy plantation owners faced extremely grim times (Sitterson, 1953).

E.5.41. Agriculture within the Atchafalaya Basin virtually ceased during the war (Comeaux, 1972). While the war disrupted agriculture in the basin, an event that was to have more far-reaching consequences was the clearing of the logjams blocking the Atchafalaya River. As early as 1816 (Darby, 1816) had commented upon the Atchafalaya River's potential for navigation, noting that the journey from the Gulf of Mexico to the Red River could be shortened by 127 miles if the Atchafalaya were rendered navigable. The logjams, or rafts, supposedly formed in 1778 (Darby, 1816) completely blocked the river (Blowe, 1820).

E.5.42. Clearing was begun in 1840 and completed in 1861 (Elliott, 1932). The immediate result was the rapid enlargement of the Atchafalaya River channel and increasingly severe flood in 1874 put an end to practically all commercial agriculture in the basin (Comeaux, 1972). The increased flooding was to become a prominant factor in bringing major cultural changes to the basin.

THE EMERGENCE OF AN EXTRACTIVE ECONOMY

E.5.43. Accelerated by war and post-war-related events, the Atchafalaya Basin witnessed the emergence of a unique form of nonagricultural, extractive economy. Several factors were responsible for this reorientation. Initially, the large pre-war landholdings along the broader, arable natural levees had forced the original small farmers and stock-raisers into less desirable locations along natural levees on the smaller waterways in the basin and in the marsh. With raft-clearing, these lowlands were more frequently and more extensively flooded. With less arable land available even for gardening and the disastrous effects of floods and backwaters on crops, swamp dwellers turned increasingly toward wild resources to supplement their garden foods. This trend continued, and many of the inhabitants turned completely to extractive pursuits. Some completely forsook the land and moved into houseboats. These floating houses, impervious to high water, could be moved as water and fishing conditions changed. Entire families could be located near the source of their economic activities without the attendent problems caused by flooding (Comeaux, 1972). Although many swamps and marsh dwellers continued to practice some subsistence farming, the extraction of wild resources had become a unique, full-fledged economic way of life in the Atchafalaya Basin. It centered on the seasonal exploitation of fish, crabs, crawfish, turtles, frogs, moss, and fur animals, in an annual round closely tied to changing water levels in the swamp and other ecological conditions (Comeaux, 1972; Begnaud and Gobson, 1975).

E.5.44. While some of the swamp exploiters spoke English (primarily around Bayous Chene and Sorrel), most spoke French. The French-speaking Acadians were among the earliest Euro-American settlers of the area and, consequently, were among the first dislocated by the expansion of the plantation system. These Canadian exiles, whose lifestyles came to be molded by adaption to south Louisiana environments, became a distinctive culture group--the Cajuns. Although eight distinct ethnic groups are now located in the basin and all share a rather homogenous set of adaptive strategies pertaining to swamp exploitation, the Cajuns have had the greatest sustained cultural influence.

CAJUNISM

E.5.45. Previous attempts to define Cajunism have utilized several different conceptual approaches. First, and perhaps most commonly, Cajunism has been defined normatively--what Cajuns do or are expected to do (Keating, 1966; King, 1970; Ketchum, 1973; DelSesto, 1975), or attitudinally--what Cajuns think or believe (Harris and Gramling, 1978; Ribon, 1966). While some minor differences are expressed by these authors, they are agreed on the point that "Cajunism" is reflected in values associated with "laissez le bon temps rouler" (translated, "let the good times roll").

E.5.46. Another approach toward delineating Cajunism might be called cultural history, or historical induction (Conrad, 1978; Rushton, 1979). Under this approach, the elements of Cajunism are traced historically to their cultural roots, and general and specific contributors and contributions to Cajunism are isolated. Specifics may be debated, but common to all cultural historical definitions of Cajunism are: exiles from Nova Scotia (Acadia); French language and culture; assimilation of some African culture traits; isolationism in Louisiana; Catholic religion; and physical environmental influences.

E.5.47. Finally, a more general approach has been used in which the primary criterion for Cajunism, or any ethnic group for that matter, is considered to be ascription and self-description (Barth, 1969). Quite simply, Cajuns are those people who identify themselves as Cajuns and are so identified by others (Tentchoff, 1975). While possibly quite accurate, this approach allows for little differentiation by outsiders.

E.5.48. Although Acadians were among the earliest settlers along the natural levees in and around the basin, their supremecy as land holders was temporary. Following the Louisiana Purchase in 1803, migration from the former British colonies into Louisiana increased tremendously. These English-speaking settlers, perhaps more ambitious and certainly wealthier than their Acadian counterparts, were looking to establish a cash-crop agriculture, and they brought with them the plantation system, complete with slaves. Less competitive than their English contemporaries, the Acadians soon sold the best land along the major bayous and retreated to the natural levees of smaller bayous and into the swamp.

E.5.49. There were many reasons why the Acadians sold their good land and moved into the swamp. First, they could not afford to build and maintain the levees and roads that were required by law for all front holders. Second, they feared debt and once in debt, they sold their land. And third, these poor, independent Acadians were considered to be a bad influence on the plantation slaves, and plantation owners were willing to buy their frontage at almost any price. The main result of the aggressiveness of the Anglo-Americans was the abandonment of such areas as the upper Bayou Lafourche by small independent farmers and their replacement by large sugar-producing plantations employing Negro labor (Comeaux, 1972).

E.5.50. Once in the swamp, gradual changes in economic practices occurred. Forced to poorer lands, the emerging Cajuns, originally subsistence farmers, turned evermore toward extraction of the swamp and marsh resources to supplement agriculture. Additional pressure for agricultural lands, and increased flooding of existing lands caused by the removal of the rafts in the Atchafalaya River, made the slow transition from agriculture to an almost entirely extractive economy inevitable. At the same time that a plantation economy was developing and flourishing along the major natural levees, a unique extractive economy was emerging in the Atchafalaya Basin and marshes of South Louisiana, associated with working class statuses. This began a physical isolation of the working class Catholic peoples in South Louisiana.

E.5.51. Buffered by linguistic barriers, the Cajun culture developed, centered on Catholic working class norms, but influenced, to be sure, by French heritage, Acadian experience, and the resources available in the environment. Cultural continuity was bolstered by the fact that mobility out of the culture required drastic individual change. Social mobility into another socioeconomic class requires that the individual adopt the values of the class to which that individual aspires (Merton and Kit, 1950).

E.5.52. Upward mobility for the Cajun generally required physical and linguistic change, since there were few if any middle class jobs in the extractive economy and middle and upper class occupations were dominated by English-speaking people. Many an individual of Acadian descent did just that and moved into Creole culture.

LUMBERING IN THE BASIN

E.5.53. One swamp resource that was not part of the extractive economic complex (presumably since it required relatively large capital outlays) was logging. Although timber was removed from the Atchafalaya Basin as early as the first half of the eighteenth century, its real commercial importance was not realized until after the Civil War. Cypress (Taxodium distichum) was by far the most valuable species available for exploitation.

E.5.54. The logging technique in use from the early 1700s to the 1880s took advantage of the rise and fall of the river. Trees were ringed or "deadened" in the fall. In the early spring the dead trees were cut. As the water rose, the logs floated from where they were felled and then were towed downstream to markets.

E.5.55. By an Act of Congress in 1849, the United States Government granted to the State of Louisiana all of the overflow and swamplands within the state that were unfit for cultivation (US Congress, 1849). The state accepted these lands in 1850, and much of the land was soon transferred to individuals having political influence (Norgress, 1947). While the Civil War slowed exploitation of the timber, the Congressional Timber Act of 1876 allowed the sale of most of the remaining land for as little as 12.5 cents per acre. With the swamp now open to exploitation, improvements and innovations in the cypress lumber industry soon followed. Principal among these improvements was the overhead skidder and pullboat. The overhead skidder utilized a cable suspended between two tall poles or trees. This allowed a steam winch to drag logs out of the swamp from distances of up to 1,000 feet. The pullboat was simply a barge with a steam-operated winch that could pull logs from 3,000 feet away into the canal in which the pullboat operated. Later, skidding the logs to a railroad was developed as a more flexible way to logging (Norgress, 1947). Beginning in the 1880s and continuing through the 1920s, cypress was removed from the Atchafalaya Basin at a phenominal pace. The introduction of the circular saw and, later, and more importantly, the band saw allowed the timber to be processed at ever-increasing rates. Saw mills and shingle mills developed along the Teche and at Morgan City (Norgress, 1947). Cypress was used for much of the contemporary construction, and today many of the older houses and barns in southwest Louisiana that date back to the turn of the twentieth century are built of cypress. Additionally, cypress shingles were shipped to the north and eastern United States and for a while were so plentiful that they sold for less than pine of a similar grade (Norgress, 1947). By 1925, the cypress was practically exhausted and the industry almost dead. The once great cypress swamps were cut out. An era had come and gone, and the esthetic and ecological character of the basin had undergone drastic revision. The lumbering years in the basin contributed much to the folklore and legends of the swamp. The swampers, who lived much of the year in camps constructed on rafts of great cypress logs, were much memorialized, if not actually envied (Coulon, 1888). Hand-hewing trees up to 6 feet in diameter from raised platforms was a difficult and dangerous occupation, and like most jobs that bear an element of danger, swamping carried a respected status.

THE GROWTH OF URBAN CENTERS IN THE BASIN

E.5.56. On the eve of the Civil War in 1860, Brashear City was recognized by the state legislature. Described in 1863 as "a miserable dirty village of a dozen houses," it was not exactly a metropolitan dream (Edmonds, 1979). With the close of the war, however, the strategic location of Brashear City began to play a crucial part in the economic reorganization of the area. It was located on the Lower Atchafalaya River, which connected all parts of the basin with the Gulf of Mexico. It also was linked to New Orleans by rail. This transportation network soon attracted outside attention, namely from Charles Morgan, a New York shipping and rail magnate. Morgan purchased the New Orleans, Opelousas, and Great Western Railroad in 1869 and operated it in conjunction with steamer lines connecting Brashear City with the Sabine River and Galveston. Its new-found role as a major terminal in east-west ship and rail traffic brought great prosperity to the town, and its grateful citizens renamed it Morgan City in honor of its benefactor.

E.5.57. In addition to improving the rail link between New Orleans and Morgan City, Morgan was also successful in dredging a channel through the mud flats and oyster reefs in Atchafalaya Bay. The channel, completed in 1847, was 10 feet deep, 200 feet wide, and approximately 6 miles long (the Morgan City historical Society, 1960). The completion of this channel permitted Morgan's steamers ingress and egress to the Gulf of Mexico, regardless of tidal or river conditions.

E.5.58. By 1880, rail links between Berwick and Vermilionville (Lafayette) were completed, and in 1882, a railroad bridge across the Atchafalaya River completed the rail connection between New Orleans and Vermilionville. With the initiation of regular rail service, the steamboats gradually began to lose their competitive edge. More reliable, faster, and safer, trains were the prime factor in the demise of the steamboats. By the 1880s, a great deal of diversification had occurred in the urban areas within and contiguous to the Atchafalaya Basin. Formerly, almost totally dependent on agricultural products and related services, basin towns--especially Morgan City--were now serving as collection and distribution centers for agricultural products, lumber, fish and seafood, moss, pelts, and waterfowl. The extractive economy that had developed in the basin funneled its products through Morgan City to New Orleans. The growth of the oyster industry was indicative of the area's potential, and was closely paralleled by increases in other economic pursuits.

E.5.59. Morgan City became a boom town, and experienced all the growing pains generally associated with rapid expansion. Seafood, freshwater fish, and lumber continued as the mainstays in the Atchafalaya Basin through the turn of the century and well into the 1930s. Once the regular steamboat traffic ceased, siltation became a continuing problem, especially in the channel through Atchafalaya Bay. Lack of a deepwater channel discouraged Morgan City's attempt to become a major port, although some shipbuilding and repair services were in existence during this time. A major boost occurred for the shrimp industry in 1937, when Captain Theodore Anderson unloaded the area's first load of offshore jumbo shrimp at the Riverside Seafood Market in Morgan City. Shrimping prior to this time had been limited to shallow water and inland bays. Rapid growth of the shrimping industry occurred thereafter, and by 1940, Morgan City was claiming the title of Shrimp Capital of the World. The channel through Atchafalaya Bay was redredged during the winter of 1939-1940, largely because of increased traffic from shrimping activities and local political pressure (The Morgan City Historical Society, 1960). By 1940, with the lumber industry on the decline, the shrimp and seafood industries were booming, and sugar production was once again on the rise. Trapping in the coastal marsh was also reaching its peak. However, other events of the time were to have major consequences on the Atchafalaya Basin.

PETROLEUM PRODUCTION AND MODERN EVENTS IN THE BASIN

E.5.60. Oil was discovered. Actually, the first oil well had been drilled on Belle Isle, a salt dome in St. Mary Parish, in 1896. The try was unsuccessful. However, 39 years and 72 dry holes later, Herton Oil Company completed an oil well in the Jeanerette area. Exploration in the basin interior was underway by 1928 and by 1940, widespread seismographic and drilling activities were being conducted throughout the basin and in the coastal marsh south of the Teche Ridge (The Morgan City Historical Society, 1960).

E.5.61. Like the early lumbering operations, petroleum-related activities altered the natural environment. Where the land is at or only a few feet above sea level, as it is throughout much of the Atchafalaya Basin, the simplest means of getting drilling and production equipment to well and tank sites was by barge through canals dug specifically for that purpose. Additionally, connective pipelines had to be installed and other canals were required to facilitate their construction. Today the Atchafalaya Basin and the marshes below Morgan City and honeycombed with canals.

E.5.62. In 1946, Magnolia Petroleum Company put down an exploratory well near Eugene Island, off the Louisiana coast, south and east of the mouth of the Atchafalaya River. The well was a failure, but an important precedent was set. Offshore drilling was born in the Louisiana gulf. Kerr-McGee soon followed and brought in the first producing offshore well in 1947 (the Morgan City Historical Society, 1960). The race was on, and offshore oil-related industries soon became the dominant economic activity in the lower Atchafalaya Basin. The shift to petroleum-related activities has brought considerable change to the basin. Dramatic increases in the population of urban areas and drastic shifts in land use, especially long water fronts, are two of the more visible changes (Stallings, et al., 1977). The economy of the urban centers in the lower Atchafalaya Basin has become "...highly dependent on offshore petroleum and gas activities" (Manual, 1977). Unable to compete for dock space with oil companies, the once large shrimp fleet was considerably diminished

(Grambling and Joubert, 1977). The extractive economic pursuits of the basin interior, so important in the early development of Morgan City, now funnel their products through the dozens of small towns that have sprung up along the Atchafalaya protection levees. The conversion of the Atchafalaya Basin into the Atchafalaya Floodway after the 1927 flood expelled the basin's residents. These hunters, trappers, fishermen, and crawfishermen moved to levee settlements or larger nearby towns. However, this migration did not hurt the extractive economy of the basin. In fact, concurrent technological advances especially the outboard motor and the planing hull bateaux have, if anything, increased access to the prime resource grounds in the basin. Recreational use of the basin has also increased at a rapid rate.

E.5.63. Today the Atchafalaya Basin is largely devoid of human habitation. Yet utilization for livelihood and recreation is greater than at any other time in its cultural history. In the 300 years of Euro-American settlement and use, the Atchafalaya Basin has undergone sweeping changes. In fact, the enormous siltation that has occurred since its transformation into a floodway, the primary release valve for Mississippi flood waters, threatens to bring even more drastic changes. The next few decades will be a critical time in the cultural and natural history of the Atchafalaya Basin.

Section 6 - BASIN CULTURE

GENERAL

E.6.1. Included in the cultural resources survey of the Atchafalaya Basin protection levees was an ehtnographic survey designed to identify and describe ethnic groups, culturally distinct lifeways, and folk cultures in the basin that may be affected by the ongoing levee enlargements. This survey was not restricted to the levee corridors but included the settlements of Henderson, Catahoula, Coteau Holmes, Bayou Benoit, Livonia, Maringouin, Pierre Part, Bayou Sorrel, Bell River, Bayou Pigeon, Plaquemine, Sherburne, Amelia, Charenton, Krotz Springs, Musson, and Bloody Bayou.

E.6.2. This requirement was included because the Corps recognized that the unique folk culture in the basin deserved further study and consideration in the planning process of the Atchafalaya Basin, Louisiana, study. The results of this survey, largely excerpted from the draft survey report by Charles Ray Brassieur (Gibson et al., 1980), are presented in the following paragraphs.

FIELD METHODS

E.6.3. The communities were canvassed during a 17-day period from 11 September to 11 October 1979. The ethnographic team was composed of two and sometimes three people under the specific direction of Charles Ray Brassieur, under the general guidance of the project principal investigator, Jon Gibson.

E.6.4. Time was a limiting factor for this investigation. Therefore, data acquisition methods had to be adjusted accordingly. Informal interview, observation, and participant observation became the principal means of investigation. Time constraints also obliged the ethnographic team to target a select informant population rather than one predicated on more desirable statistical sampling procedures. Public officials and community leaders, e.g., town officers, religious leaders, owners and managers of business establishments, and other public servants, were identified as the most likely sources of information about varied aspects of the communities. These were sources that, because of their leadership roles, might be more willing to discuss their communities than the average person, who probably could not have been found in the time allotted to each town. Thus, in a sense, the information is nonrandom, or biased. This probably has more serious consequences for quantitative, rather than qualitative, dimensions, but the latter cannot be disallowed because of the possible social distances between the levels of community hierarchies. The Atchafalaya ethnographic survey must be regarded as a highly preliminary statement, only a beginning toward the exposition of an Atchafalaya ethnography.

IDENTIFICATION AND DESCRIPTION OF ETHNIC GROUPS

E.6.5. Simple identification and description of ethnic groups in the Atchafalaya region is no small task. George A. DeVos (1972) suggested that precise definitional qualities common to all ethnic groups are virtually impossible to obtain. After more than a decade devoted to ethnic matters, James H. Dorman (1980) reported that "the absence of conceptual and definitional clarity is the central problem in ethnic studies today."

E.6.6. When the term "ethnic group" was first defined in the Dictionary of Social Sciences, in 1964, the emphasis was on shared cultural traits. Melvin Tumin, who supplied the entry (Tumin, 1964), defined an ethnic group as: "...a social group which, within a larger cultural and social system, claims or is accorded special status in terms of a complex of traits (ethnic traits) which it exhibits or is believed to exhibit." Together with shared cultural traits, an accepted definitional quality of ethnic groups pertained to common historical origin. William S. Bernard (1972) stated:

> ...ethnic groups are people who have been brought up together under a particular cultural roof. They share the same ways of doing things, the same beliefs and institutions, the same language and historical background.

Using these definitional criteria, ethnic studies generally proceed by examining outwardly manifested, objectively perceived cultural criteria.

E.6.7. In 1969, however, a volume edited by Fredrik Barth, entitled Ethnic Groups and Boundaries, revolutionized the concept of ethnicity and ethnic groups. In the introduction to this volume, Barth (1969a) insisted that the "cultural roof," formerly of principal importance in the analysis of ethnic phenomena, was not a primary and definitional characteristic of ethnic groups. To the contrary, Barth (1969a) argued that:

> The nature of continuity of ethnic units is clear: it depends on the maintenance of a boundary. The cultural features that signal the boundary may change, and the cultural characteristics of the members may likewise be transformed, indeed, even the organizational form

> of the group may change--yet the fact of continuing dichotomization between members and outsiders allows us to specify the nature of continuity, and investigate the changing cultural form and contents.

Barth's statement shifted analytical focus from the inconsistent and situational cultural content of the group to the social boundaries that separate them.

E.6.8. But if the entire range of cultural content is not important to group maintenance and if the cultural features that signal its boundary may change, how is the ethnographer to recognize meaningful boundary markers? Because in Barth's model, self-identification is the critical criterion of ethnic identity (Barth, 1969), these boundary markers are perceived and agreed upon by members of the ethnic group. The ethnographer, then, is directed to a study of boundary markers subjectively defined by members of the ethnic group. Apparently, no amount of empirical observation from an etic perspective will illuminate these parameters so they are consequential only in the emic perceptions of an ethnic group's members.

E.6.9. Factors leading to the situational nature of these subjectively established boundary markers, according to Barth, pertain to intergroup competition for scarce resources (Barth, 1969). Actually, this concept was existent before Barth's Ethnic Groups and Boundaries. Beyond the Melting Pot (Glazer and Moynihan, 1963) explored the manner in which ethnic groups function as common interest groups by constantly changing and reorganizing their structures to meet challenges posed by other groups. John Paden (1966), taking this argument a step farther, discussed changes in ethnic identity from one social encounter to another (Hicks, 1977). Throughout the 1970's, ethnic investigators repeatedly pointed to the dynamic situational nature of ethnic groups in conflict and competition with other groups (Nagata, 1974; Despress, 1975; Patterson, 1975; Schiller, 1977). These findings commonly implied that ethnic group formation was accomplished by instrumental choices of members as they evaluated their material well being. As Dorman (1980) has pointed out, this is the ultimate statement of the subjectivist viewpoint. Ethnicity is reduced to an exlusively circumstantial phenomena.

E.6.10. Reacting to Barthian subjectivism, Wsevolod Isajiw (1974) insisted that ethnic group membership is involuntary. The link between ethnic group continuity and the socialization process, according to Isajiw, requires common historical origin among members of the same ethnic group. A person is born into an ethnic group and socialized into the special cultural traits of that group. No choice is involved.

E.6.11. The preceding summary of theoretical issues illustrates some of the ambiguities in the field of ethnic studies. There are no precise, widely accepted cirteria by which to differentiate ethnic groups; indeed, there is no generally acknowledge definition applicable to all groupings of ethnicity. Ethnographers choose between one of two polarized conceptual stances, the subjectivist, or the objectivist view; or alternatively (van den Berghe, 1975); (DeVois, 1975), select some form of eclectic compromise between the two viewpoints. The Atchafalaya ethnic data will be viewed from both perspectives.

E.6.12. The following part of this section is structured around Isajiw's (1974) breakdown of the five most common features used by students of culture in defining ethnic groups: common ancestral origin, language, race, religion, and same culture or customs. As Barth suggests (1969a), these cultural attributes are differentially pertinent to the question of ethnicity, depending upon the particular ethnic group involved. Informant commentary, observations made by field personnel, and supplementation from existing literature supply the base data for this study.

ETHNICITY AND COMMON ANCESTRAL ORIGIN

E.6.13. A discussion of ancestral origin is a good place to begin analysis of ethnic groups, if for no other reason than the historical perspective it offers. The one identifiable group with longest historical ties to the Atchafalaya Basin is the Chitimacha Indian tribe. The original tribal territory was a triangular trace of land subsuming the middle and lower Atchafalaya Basin. No groups of Indians, other than the Chitimacha, remain in the Atchafalaya Basin proper today.

E.6.14. The Chitimacha became wards of the Department of the Interior Bureau of Indian Affairs in 1925, when they were accorded reservation status and 283 acres of land in the Charenton community (Gregory, 1979). Since that time, a newly constructed school, tribal center, museum and park facilities, and government stipends, have been established to entice the Chitimacha to maintain residence within reservation boundaries.

E.6.15. Until the twentieth century, Chitimacha society was organized into matrilineal clans (Stouff, 1974). The leaders of each clan and their families were considered nobles, while the bulk of the people were accorded the status of commoners (Swanton, 1911). This rank system, unlike the Natchezean system (Brain, 1971) was perpetuated by class endogamy. Long-lived noble lineages developed and were maintained for hundreds of years. Ancestral origin was, in pre-twentieth century Chitimacha society, essential to ethnic identity.

E.6.16. By the 1930's, Chitimacha chiefs, like Benjamin Paul, came to be selected more out of respect than because of heritage (Gregory, 1979). Many of the rigid class distinctions deteriorated during the twentieth century, and, when the last traditional chief, Emile Stouff, died in 1978, practically all vestiges of traditional social hierarchy died with him. Before his death, Stouff had instituted a change from a chieftan form of leadership to a governing tribal council headed by an elected chairperson. Today relatively few Chitimacha are familiar with the original clan and caste system (Faye Stouff; personal communication, 3 October 1979).

E.6.17. As Gregory points out (1979) the family continues to perpetuate Chitimachan identity. The Chitimacha are organized into large extended family groups, not unlike that of the extended Creole or Acadian family. The change in social system that occurred during the twentieth century has not diminished the importance of ancestral origin as a primary marker of ethnic identity. Ancestral ties with the native, aboriginal inhabitants of the Atchafalaya Basin area continue to distinguish the Chitimacha from other regional, ethnic groups.

E.6.18. Perhaps the most important immigrants to enter the basin (if not in size, then certainly in sustained cultural influence) were the refugees expelled from Acadia by the English in 1755. These Acadians came to Louisiana in two major pulses; about 2,400 arrived from Acadia, the English Atlantic Seaboard Colonies, and Saint-Domonique between 1759 and 1776, and another 1,600 came from France in 1785 (LeBlanc, 1979). Inasmuch as the Acadians chose to gather from various corners of the western hemisphere and locate on Louisiana soil during the last half of the eighteenth century, it must be assumed that ancestral origin was indeed a powerful factor influencing ethnic identity and continuity. Conrad (1978a) argues that the Acadian reunion in Louisiana can best be explained by a strong desire to perpetuate a cultural identity developed in Acadia. These strong ties with a remembered ancestral origin are particularly interesting when one considers that three-quarters of the immigrants who arrived in 1785 had never been in Acadia (LeBlanc, 1966).

E.6.19. Upon arrival in Louisiana, some Acadians settled above New Orleans adjacent to the German settlements while others located at the newly established District of the Attakapas on Bayou Teche (Conrad, 1978b). As the plantation system expanded early in the nineteenth century and wealthy Americans poured into the newly acquired United States territory, the Acadians (as well as many of the Spanish speakers) were pushed even further away from the prime natural levees. Not able, or perhaps not willing (Reilly, 1978) to compete with the ambitious Anglo-Americans, the Acadians retreated to the swamp where they began to develop the skills, technology, and know-how necessary to exploit a new environment.

E.6.20. The peoples who adapted to the swamp during the nineteenth century were not of a single national origin. The Gallic persuasion that dominated the acculturative process in southern Louisiana has been termed Cajunization (Waddel, 1979), because the singlemost important conditioning factor was the Acadian model. Simple geographic proximity and intermarriage resulted in the rapid enculturation (socialization) of Germans, Hispanics, Old World and Canadian French, Anglo-Americans, Indians, and doubtlessly people of other ancestral origins. Several authors have argued that geographical isolation was responsible for the distinctive Cajun lifestyle (Gilmore, 1933; Conrad, 1978a), but given the incredible absorptive quality of emergent Cajunism, isolation must be ruled out as an important factor. The continued admixture of peoples of various ancestral origins into the dominant Cajun group resulted in a cohesive, if somewhat hybridized, social phenomena that continues to exhibit dynamic and vibrant qualities that simply cannot be explained by geographic isolation.

E.6.21. Though the modern Cajun belongs to a distinctive group, whether viewed from within or without the social boundaries of ethnicity, ancestral origin often does not appear to play a major role in ethnic group definition.

E.6.22. Another social label that has been applied to French-speakers in the Atchafalaya vicinity is the term Creole. Like the term Cajun, Creole has confused and perplexed anthropologists and ethnic group members alike. Also similar to the term Cajun, the use of Creole as a noun in reference to a social category must be viewed in terms of diachronic and synchronic variations. These variations have in the past and continue in the present to accord varying degrees of emphasis on ancestral origin as a vital definitional criterion.

E.6.23. The present fieldwork in Atchafalaya communities confirmed the highly situational use of the term. An English-speaking Black man from Musson, who professed not to be a Creole, considered any French-speaking person a Creole. One French-speaking Cajun from Henderson considered Cajuns and Creoles as the same group. Another French-speaking Cajun from Henderson considered both Cajuns and Creoles to be of mixed ancestry but distinguished Creoles as having some black blood. A woman from Coteau Holmes, who had assimilated both Cajun culture and the Cajun language during her lifetime, considered Creole to be the same as mulatre (mulatto). If there are native black and white French-speakers who do consider ancestral origin as important in distinguishing identity, the present investigation failed to identify them.

E.6.24. Finally, there are French-speakers living in the Atchafalaya Basin area whose ancestors came directly from France to Louisiana at various times but who insist that they are neither Cajuns nor Creoles. The ancestors of some of these people, for example, were

French Royalists who fled to Louisiana during the French Revolution (Guitierrez, 1979). Thus, one might tentatively draw the conclusion that distinctive French ancestry might furnish the definition for a separate group of French-speakers apart from Cajuns or Creoles. However as the other dimensions of ethnicity are examined, it may be seen that "Frenchmen" neither constitute a clear grouping nor function collectively as a group separate from other French-speakers.

E.6.25. Italians are also prominant among the non-French speakers living in the Atchafalaya area. Between 1880 and 1910, more than 30,000 Italians immigrated to Louisiana, chiefly to work as laborers in the sugar industry (Rathburn, 1979). Italians are still numerous today in areas where sugarcane is grown or was once the major crop. Relatively large Italian enclaves were confirmed in Maringouin, Charenton, Morgan City, and St. Martinville. The Italians have not been as strongly affected by the Gallic acculturation process as the earlier immigrants to Louisiana. This is probably due to their relatively late arrival and exposure to the process of Cajunization, which itself was being influenced by a more generalized modern Americanization.

E.6.26. Unlike other groups, ancestral origin seems to play a prominant role in distinguishing Italians from other groups in the basin. As several informants have explained, the proof of Italian identity rests in surnames.

E.6.27. Perhaps the fastest growing group in the basin area today is an assortment of English-speaking Americans. The Anglo-Americans became the first nonaboriginal people to settle in and around the basin in the mid-eighteenth century, when Thomas Berwick set up farming operations around the current sites of Morgan City and Berwick (Grambling, 1978). The major period of Anglo-American migration to Louisiana began after 1803, and reached its peak between 1850-1860 (Treat, 1967). During this period, Anglo-American plantations sprang up both within and along the fringes of the basin. Plantations were located on bayous Maringouin, Grosse Tete, Sorrel, and Pigeon, and in the center of the basin along Bayou Chene (Comeaux, 1972), and in the southernmost reaches around present-day Morgan City (Grambling, 1978).

E.6.28. During the remainder of the nineteenth century, other Anglos from the North entered the area with the development fo the cypress lumber industry (Spitzer, 1979). Others took part in the fishing and trapping commerce that also was expanding. After the great 1927 flood, the population in the interior of the basin began to disperse. The Anglo-Americans generally resettled in the Morgan City and Lower Teche region or in the community of Bayou Sorrel on the eastern fringe of the basin. With the rising importance of Morgan City as a terminal for the oil industry, Anglo-American immigration to this area has drastically increased in recent years.

E.6.29. The Anglo-Americans are distinctively separate from other ethnic groups living in the basin area, but this distinctiveness seems to have little to do with ancestral origin. Throughout the nineteenth and twentieth centuries, acculturation across ethnic boundaries occurred. Individuals with English surnames, for example, are thoroughly integrated with and assimilated into Cajun communities along the western edge of the basin. On the other hand, a considerable number of individuals with French and Acadian surnames became ethnically Anglo. Case (1973) has pointed to a number of these individuals who lived at the Bayou Chene community before its dispersal, and Spitzer (1979b) has followed their resettlement to the Bayou Sorrel locality. Countless others can be found along the Lower Teche and in the Morgan City vicinity. Among the Anglos who became Cajun, as has been noted, ancestral origin has played no important role. Similarly, ancestral origin is a relatively insignificant factor to monolingual English-speaking individuals of Acadian or French descent who have intergrated into Anglo-American communities.

E.6.30. Yet another distinct group inhabiting the basin area includes English-speaking blacks, who are here referred to as Afro-Americans. Like the black Creoles, the Afro-Americans entered Louisiana as a result of the Atlantic slave trade. Originally at least, the distinctions between the black Creoles and the Afro-Americans were due to the ethnic affiliations of their owners. Slaves who were owned by Anglo-Americans generally arrived in Louisiana somewhat later than those belonging to French owners. Many were taken to Louisiana by planters from the Tidewater region after 1803 (Spitzer, 1979b). The settlement loci of these slaves corresponded to the location of Anglo-American plantations in the basin vicinity. After the Civil War, most Afro-Americans remained as share-croppers or tenant farmers on the same lands where their ancestors had settled. When the lumber industry expanded around the turn of the twentieth century, many blacks entered the Atchafalaya Basin on a seasonal basis as employees for large lumber operations (Marionneaux and Marionneaux, 1979). The Afro-Americans (as well as the black Creoles), however, were barred from entering the interior of the basin in pursuit of trapping or fishing careers by entrenched white groups who had already monopolized that economic niche.

E.6.31. Today, the majority of the Afro-Americans reside at or near their original locations. Sizable communities were noted in Amelia, along Bayou Maringouin, and in the Lower Teche region. Ancestral origin is no more important as a distinguishing feature of ethnicity among the Afro-Americans than it is among the black Creoles. Social and cultural factors, other than ancestry, separate this group from others of the area, factors which took effect after settlement in the New World.

E.6.32. Several other ethnic units, numerically less significant than those previously discussed, have settled in the basin vicinity. Of these, the Jews are probably the most numerous. Jews have been in Louisiana since 1718 (Kaplan, 1957), but since they generally cluster around urban areas (Spitzer, 1979b), the basin itself has held little attraction. The most cohesive Jewish community in the vicinity is located in New Iberia and serves individuals from the Franklin and Jeanerette areas (Kaplan, 1957). A community leader and long-time resident of Amelia stated that a few Jews inhabit that community. If the Jews from elsewhere in the basin region are comparable to the community in New Iberia, it is safe to say that ancestral origin means little to the cohesion of their ethnic group. Kaplan (1957) reports that French, German, and Eastern European Jews comprise a single ethnic unit in the community at New Iberia.

E.6.33. The most recent ethnic group to enter the basin vicinity is comprised of Vietnamese refugees. Within the last 5 years, resettlement of these people by the Federal Government has brought them into the ethnic portrait of south central Louisiana. Large Vietnamese aggregates were observed in Henderson and Amelia. In the Henderson community, they work in the seafood industries; in Amelia, they are laborers in various oil field equipment fabrication plants. Though no Vietnamese were interviewed during this survey, other informants in the towns in which they live claim that the new arrivals form chohesive social units that remain largely apart from other parts of the communities. In this particular case, ancestral origin is a key factor in their distinctiveness.

E.6.34. The importance of ancestral origin as a factor of ethnic consolidation varies from group to group. Ethnic identity among the Chitimacha Indians, the Italians, and the Vietnamese does seem to depend, at least partially, on origin. Factors affecting the formation and continuity of other ethnic units in the basin vicinity, on the other hand, have considerably minimized the significance of ancestral origin.

LANGUAGE AND ETHNICITY

E.6.35. The following discussion does not constitute a substantial linguistic analysis of verbal behavior in the Atchafalaya area, or even of selected parts of the basin. Rather it is an inquiry into one small aspect of sociolinguistics; an inquiry centering on the question: "Is language a key factor to ethnic identity?"

E.6.36. It was stated previously that ancestral origin was pertinent to the makeup of a few ethnic groups; the Chitimacha Indians being and example. The social use of specific language competencies, on the other hand, does not seem to aid in defining Chitimacha ethnicity.

E.6.37. No language other than English was encountered during field work at the reservation. As a basically monolingual, English-speaking group, the Chitimacha are not distinguished by language from other English-speaking ethnic units in the basin area.

E.6.38. Another case in which language fails to circumscribe ethnicity may be found among the Islenos and other Hispanic peoples. Peoples of Hispanic ancestral origin around the basin have largely been assimilated into other ethnic groups. Over the years, assimilation has included the Spanish language.

E.6.39. French language use in the basin, has, however, remained an integral means of communication. In South Louisiana in general, there are, in the estimation of some linguists, four variant forms of French in use: Standard, Cajun, Creole, and the Acadian variant heard in the Breaux Bridge area (Waddel, 1979). Along the fringes of the Atchafalaya Basin, two of the forms dominate, Cajun and Creole.

E.6.40. The following discussion centers on the relevance of the two spoken French forms, Cajun and Creole, to the matter of ethnic identity. The Cajun language, whether dialect, patois, or whatever, is widely spoken in villages along the western fringe of the basin as well as in the areas of Pierre Part, Belle River, and Bayou Pigeon, located on the east side of the basin. Creole, on the other hand, is distributionally limited to the western edge of the basin. The two variants are distinctive. In extremely simplified terms, Cajun is a seventeenth century version of rural French containing certain French archaisms, a number of loan words from Spanish, English, and various Indian languages (Read, 1931), and a simplified grammar (Phillips, 1978). Creole is perhaps best understood as a French lexicon within an Africanized phonology and unique syntax (Spitzer, 1979a). Spitzer (1977) notes that in its "deepest form," Creole is unintelligible to speakers of Cajun French.

E.6.41. Waddel (1979) suggests that there is some coincidence between distinctive racial groups and the variants of French spoken; Creole is often associated with the black Creole group, while Cajun is associated with the white population identified externally and internally as Cajun. He further notes, however, that many whites and blacks are bilingual in Creole and Cajun and that Creole appears to be the dominant form among both blacks and whites in the Atchafalaya area. Survey encounters with several white Creole-speakers confirm that these forms of French should not be strictly linked with race.

E.6.42. In one sense, survey information overwhelmingly indicates that personal and group identity is defined by French verbal behavior. Most French-speakers in the basin area have some competence in the English language. The identity of bilingual speakers is often defined within the complex rules governing code switching (Eidheim, 1969), and switching between English and French does have identity connotations. In public situations, French is used among relatives, members of the same occupational groups, friends, and other "in-group" acquaintances, while English is used with preceived "outsiders." Quite often, French is used as a "secret code" to allow insiders to communicate messages not intended for the ears of outsiders.

E.6.43. In another regard, in every French-speaking community visited during the survey, the failure of French usage to cross generational boundaries was noticed. In Catahoula, one of the most characteristically French communities in the Atchafalaya region, a knowledgeable community leader stated that individuals under 35 years of age often do not speak French. The implications of this finding for ethnicity are clear. The French language is an important identity marker among French-speakers, but it is not essential to defining ethnicity of their children who, by dint of consanguineous ties, are also numbered among ethnic group members.

E.6.44. To a more particular issue, it may be asked if the Creole-Cajun language dichotomy provides a key boundary marker for separate identity groups among French-speakers? The answer seems to be no, or at least it provides an unreliable indicator. In addition to the factor of inter-generational discontinuity previously discussed, there is a widespread bilingual competence in both language forms. Since black and white French-speakers alike use both Creole and Cajun forms, there is no clear ethnic dichotomy predicated on them alone.

E.6.45. Another case in which language seems to be a paramount link to ethnic definition involves the Vietnamese. Informants in Henderson and Amelia testify that most of the adult Vietnamese speak little or no English. There are presently adult classes being held in Amelia to teach basic conversational English, but only a very small percentage of adult Vietnamese attend these classes. Vietnamese children, on the other hand, attend public schools and are learning English at a much rapid pace. Often, the children act as tutors and translators for the adults. In Henderson, one informant noted that some Vietnamese show a remarkable propensity for the English language but, in general, a communication gap exists between locals and that oriental group.

E.6.46. Excluding French and Vietnamese, English is the only other language of widespread social importance in the basin. There may be Italians who have retained some competence in that language but, if so, their numbers must be relatively small and, more importantly, no evidence of the social relevance of Italian has been discovered. Some Italians may speak French as a second language, but the majority are monolingual English speakers.

E.6.47. The Anglo-Americans, Afro-Americans, Italians, Chitimacha Indians, and Jews (as far as can be ascertained) are predominantly English-speakers. Their common use of English does distinguish them from French-speaking individuals inhabiting the basin area.

RACE AND ETHNICITY

E.6.48. The concept of race as used here does not pertain to physical genotypical characteristics. The concept of a "pure" race, in the empirical sense, has long been abandoned by anthropologists. If the concept itself ever had usefulness, its applicability to south Louisiana would be especially hard to justify. The fact, however, that perceived racial differences are important has nothing to do with the empirical validity of any biological category. Race is definitely a cultural category. Isajiw (1974), invoking Barthian subjectivism, pointed out that when the subjective self-definitions "of people remain the same over a period of time, they become part and parcel of the people's culture." Race, as a category of ascription and self-ascription is a factor in ethnicity.

E.6.49. Perceived racial affiliations do structure intergroup relationships in the Atchafalaya region. Chitimacha Indian ethnicity, for instance, is officially defined in racial terms. To be a Chitimacha, one must be prepared to prove at least one thirty-second Chitimachan "blood." This racial expression forms the border between their group and others who do not possess Chitimacha racial features. While this view may not coincide with various definitions of Indian identity maintained by the Federal Health Education and Welfare Department (Daily Advertiser 1979), it is of considerable importance on the Charenton reservation.

E.6.50. Racial categorization also contributes to ethnic distinctions between French-speaking groups in the Atchafalaya Basin vicinity. It involves the black-white dichotomy. This fact is not particularly evident from the literature of Acadians, no doubt because racial categorization frequently is not pertinent to social identity in many areas. Blacks are often considered legitimate members of the Cajun group, and either black or white may be Creole. Nevertheless, evidence gathered during the survey unequivocally indicated that racial categorization as perceived by white French-speakers is essentially important to ethnic distinctiveness. It was discovered that both black and white French-speakers of the Henderson area are Catholic, speak the same languages, and have similar cultural traits. The black French-speakers, however, do not attend Our Lady of Mercy Catholic Church in Henderson because, as informants indicated, they are not welcome there.

E.6.51. White French-speakers living around the fringe of the basin, referred to here as Cajuns, do not consider that blacks, no matter which language, religion, or culture they practice, belong to the same ethnic group as they themselves do.

E.6.52. There are other evidences of ethnic dichotomization based on race. This dichotomization is apparent in the physical spatial segregation and/or complete absence of black settlement in many

Basinal communities. Krotz Springs, a community inhabited by both Cajuns and Anglo-Americans, has no black residents. There are no blacks in the Anglo community of Bayou Sorrel. In Amelia, which is predominantly Anglo-American but with a strong Cajun contingency, Afro-Americans live within a small geographically distinctive precinct. Settlement outside the boundaries of the Chitimacha reservation.

E.6.53. The Hispanic race, or the broader Latin category, seems to be of less importance in defining ethnicity than either "black" or "red" categories. This survey found no evidence of an ethnic group comprised entirely of Hispanics.

E.6.54. Members of two other basin groups may consider racial categories as important to ethnic definition. The Jews, though none were interviewed by the survey team, generally seem to espouse the belief of Jewish racial separation. This attitude of racial distinctiveness could be based upon an extremely high rate of endogomy among the Jews (Kaplan, 1957). The Asian race also, for the time being at least, significantly sets the Vietnamese apart from other ethnic groups. Race seems to be one of many characteristics that results in their distinctiveness.

E.6.55. In conclusion, while there are no empirically valid, biologically distinct "black" or "white" races in the basin area, these culturally perceived racial categories are pertinent to ethnic boundaries. Black-white dichotomization is essential in distinguishing Cajuns from black Creoles, and Afro-Americans from Anglo-Americans. This dichotomy probably affects the self-definition of Italians and individuals of Hispanic stock as well. In the case of the Chitimacha, this white-black dichotomy "colors" the blood rules of ethnic identity to which they ascribe. The Vietnamese, and possibly the Jews, are distinguished by racial characterizations that exceed this simple white-black duality.

RELIGION AND ETHNICITY

E.6.56. Apart from the peculiarities that mark French Catholicism, the Catholic religion delineates ethnic boundaries in a more general way. The Catholic religion, in general, does not act as a boundary mechanism among the Cajuns, black Creoles, Chitimacha, Italians, or Vietnamese. They are predominantly Catholic. If anything, the Catholic religion serves as a bond among these peoples. Granted that the bond is often tenuous, certainly not strong enough to dissolve ethnic distinctions, it nevertheless sets these groups apart from the Anglo- and Afro-Americans who generally adhere to various protestant denominations.

E.6.57. The boundary between Catholicism and Evangelical Protestantism cannot be easily mapped. It seems logical to view the entire Atchafalaya region, both eastern and western fringes, as a zone of blurred boundary distinctions between Catholicism and Protestantism, at least in the gross geographical sense.

ETHNICITY AND CULTURE

E.6.58. As previously mentioned, Isajiw (1974) determined that "same culture" or "cultural traits" was a category of attributes chosen frequently by social scientists to define ethnic groups. It is clear that some if not all of the categories previously discussed could easily have been subsumed by this heading. Language, religion, and cultural perceptions of race are all cultural categories. It could likewise be argued that ancestral origins, and myths surrounding them, should also be included under a category of cultural attributes. The fact is, the concept of culture is so inclusive that compartmentalization is necessary to facilitate analysis. Since the relationships between ethnicity and ancestral origin, language, race, and religion have already been discussed, this residual category deals with everything cultural that has not been covered.

E.6.59. Symbols of ethnicity are occasionally corporal entities wrought by human hands. Examples of these objects can be seen at the Chitimacha tribal museum. As a class of objects that represent continuity in uniquely Chitimacha custom, they are a symbol of Chitimacha identity.

E.6.60. But symbols of ethnicity need not be works of art or even be skillfully executed. Wherever Cajuns live around the fringes of the basin, statues of the Virgin Mary can be seen enshrined in front yards. The placement of many of these shrines atop liquid gas tanks in rural areas has inspired Rushton's appellation, "Our Lady of the Butane Tank" (1971).

E.6.61. Another symbol of Cajun ethnicity is the crawfish. As a symbol of dauntless tenacity and stubborness, the Cajun sees the crawfish as an embodiment of his own personality. The crawfish symbolizes unwillingness to change. The Atchafalaya Basin is the home of the crawfish and is a symbol of Cajun ethnicity.

E.6.62. Anglo-Americans do have institutions that contribute to their ethnic solidarity. One of these, the Accelerated Christian Education (A.C.E.) schools, can be found in Bayou Sorrel and, suprisingly enough, in Pierre Part. These schools resulted from fundamental Baptist reactions against the public school system, particularly the teaching of evolution. Bible passages are the "textbooks" for grades kindergarten through twelfth. This school system personifies the characteristics of independence held by many of the Anglo-American residents of the basin area.

E.6.63. The Vietnamese, Italians, and Jews also have peculiar cultural traits that figure in the maintenance of their ethnic identity. Unfortunately, the limited field work did not produce any new data relevant to these groups.

ETHNIC GROUPS IDENTIFIED

E.6.64. The present research in the Atchafalaya Basin has resulted in the identification of eight separate ethnic units: the Chitimacha, Cajuns, black Creoles, Anglo-Americans, Afro-Americans, Italians, Vietnamese, and Jews. Various combinations of ethnically pertinent attributes distinguish these groups from one another. Considerable difficulty plagued attempts to divide the French-speakers of the Atchafalaya region into ethnic constituents. These populations have been classified into two ethnic units, the Cajuns and the black Creoles.

FOLK CULTURE IN A FOLK SOCIETY

E.6.65. Several important sociocultural and technoeconomic realities of the Atchafalaya area do not conform to the ideal folk society. While some individuals choose to live in remote settings, for instance, no social unit can truly be described as isolated. Illiteracy is common among individuals, but the term cannot be applied to any social group. Nineteenth and twentieth century contact with industrial America has insured a level of technological complexity, which presumably neither Redfield (1947) nor Foster (1953) would accept as characteristic of a folk society. And, while swamp exploitation is intergrated into the independent lifestyle of many locals, profit cannot be underestimated as a prime motivator. In short, the folk industries described by Comeaux (1972) do not generally fit traditional conceptions of the folk society.

E.6.66. Other characteristics of social groups in the swamp area, however, suggest that folk societies do exist. Relatively small communities of individuals who share intimate communications through daily face-to-face relationships are found along the fringes of the basin. In many cases, these communities are populated by individuals who share a set of generally homogenous customs. Some of the societies, particularly those composed of Cajuns, black Creoles, and Chitimacha Indians, do have powerful, sacred components that seem to touch nearly every aspect of social life.

E.6.67. Inasmuch as some communities are linked to, or separated from, others on ethnic grounds, there appears to be more than one folk society. In fact, the concept of the folk society corresponds quite well with that of the ethnic group. Both are biologically self-sustaining groups whose members fill all of the necessary social roles. Members of both groups generally speak the same language and share a homogenous set of customs and values. No segregation occurs among members of the same ethnic group or folk society based upon racial perceptions.

E.6.68. On a conceptual basis, however, there seems to be one important factor that separates the folk society from the ethnic group--the manner in which group cohesion is maintained. If ethnic group cohesion can be fostered and maintained by formal educations, the cohesion of folk societies can not. The traditions and customs that bind the folk society are transmitted by way of folklore. Folklore may occur in a variety of forms, including verbal and nonverbal behavior, as well as material objects that embody important stylistic conventions, but there is no room in the folk society for formal socialization.

E.6.69. In the Atchafalaya Basin region, ethnic groups and folk societies cannot be distinguished from one another in terms of socialization. Though public education is offered in the area, the body of conventional understandings that contribute to group cohesion is not taught in the classroom. To the contrary, formal education tends to socialize the student to standard American norms which threaten to replace the distinctiveness of both ethnicity and folk culture. But for the present, despite the onslaught of modernization, it is still possible to identify folk societies. These groups do not perfectly correspond to Redfield's ideal construction of the folk society, but neither do they approach the ideal type that occupies the opposite end of the rural-urban continuum.

FOLK CULTURE OUTSIDE THE FOLK SOCIETY

E.6.70. As previously mentioned, folk culture articulated upon exploitation of swamp resources cannot be ascribed to any particular social group. Anglo-Americans, Cajuns, Indians, and members of other social units share a more or less homogenous set of adaptive strategies pertaining to swamp exploitation. These folk activities include wetland lumbering, fishing, crawfishing, crabbing, frogging, trapping, turtle industry, alligator hunting, game hunting, bee industry, and the moss industry. Brassieur (Gibson et al., 1980) and Comeaux (1972) describe these folk industries in detail.

CONCLUSIONS

E.6.71. The term "folk culture" has been defined as shared conventional folk understandings. In reviewing traditional concepts of the folk society, it has been seen that folk culture exists both within particular folk societies and outside their boundaries as well. But whether folk culture occurs within a societal whole or within a specific societal segment, such as an occupational group, it is maintained and transmitted by folklore. Folklore, which embodies verbal or nonverbal behavioral or material forms, is the analytical unit that puts the researcher in touch with folk culture. The study of folk culture is necessarily a study of folklore.

E.6.72. Within this century, the Atchafalaya Basin has changed from a watery cypress wilderness to a semi-wild spillway that is rapidly on course to total mastery by a dominant industrial civilization. In 1980, there are still living culture bearers of a way of life that adapted to the great swamp in its pristine conditions. One can still hear stories of cypress stands that defy comparison to anything presently growing in the basin; of catfish longer and heavier than the fisherman who dragged them out of the swamp; of panthers that could swim faster than a pirogue; of entire fishing communities built on piers in the middle of the swamp; of great floods of 1882, 1912, and 1927; and of steamboats that plied Atchafalaya and Bayou Teche waters. In the all-too-near future, the bearers of these folk memories will no longer be around to share the understandings of a landscape and cultural adaptation that is doomed to extinction. As significant cultural resources, folklore and the bearers of Atchafalaya Basin folk culture deserve considered attention.

Section 7 - NATIONAL REGISTER PROPERTIES

E.7.1. The National Register of Historic Places, published in the "Federal Register" dated 6 February 1979 and the monthly and annual supplements through 27 October 1981 has been consulted and only two cultural resources 16SM45 and 16SMY52, within the Atchafalaya Basin Floodway have been determined eligible for inclusion in the National Register (US Department of Interior, 1979). The Nutgrass archeological site, 16SM45, is a significant shell midden located on the west bank of the Port Allen-Morgan City Intracoastal Canal south of Belle River Landing, Louisiana. The site was discovered and investigated by Louisiana State University during their extensive preliminary survey of the Atchafalaya Basin in 1974 and 1975 (Neuman and Servello, 1976). Subsequent to its determination of eligibility to the National Register, the Nutgrass site was protected from erosion by placement of stone on the bank and adjacent underwater slope by the US Army Corps of Engineers in 1975. The Avoca Island Pumping Plant Number 1, 16SMY52, is located on the east bank of Bayou Shaffer south of Morgan City, Louisiana. The structure was a key element in a pioneering land reclamation project in the Louisiana marsh. Built between 1910 and 1914, the plant was one in a system of three pumping stations which drained the 16,000 acres of Avoca Island. The property was investigated during the intensive cultural resources survey of the East and West Atchafalaya Protection Levees conducted by the University of Southwestern Louisiana in 1979-80 under contract to the US Army Corps of Engineers, New Orleans District (Gibson et al., 1980). No other cultural resources in the project-affected area are presently listed in or have been determined eligible for inclusion in the National Register.

E.7.2. The draft report on the findings of the cultural resources survey of the East and West Atchafalaya Protection Levees identified 12 cultural resources in the survey corridor as significant and eligible for inclusion in the National Register. These 12 resources include the Nutgrass archeological site, 16SM45, which had previously been determined eligible for the National Register, and the Avoca Island Pumping Plant Number 1, 16SMY52, which has subsequently been determined eligible to the National Register.

E.7.3. Because the Avoca Island Pumping Plant Number 1, 16SMY52, is located in the potential environmental impact area of the project, a determination of eligibility was requested from the Keeper of the National Register pursuant to Title 36 CFR, Part 800. The resource was determined eligible on 14 September 1981, and a determination of no effect was executed on 14 September 1981 after minor alteration of the project design to avoid any impacts on the property.

E.7.4. Four of the 12 significant resources (16SYM104, 16SMY107, 16AV33, 16AV35), although located in the survey corridor, are not located in the potential impact area of the project; and therefore, no further action is planned. For the remaining 7 significant resources (16IV4, 16SM75, 16SMY130, 16SMY66, 16SMY2, 16SM50, Register-eligible 16SM45), precise construction limits have not yet been determined. As project design continues, a determination of eligibility will be requested and the compliance procedures outlined in Title 36 CFR, Part 800 will be initiated for each of these resources located in the potential impact area of the project.

E.7.5. In addition, the intensive cultural resources surveys of the other project features of the selected plan, which will be conducted during the next stage of planning, may locate additional cultural resources eligible for inclusion in the National Register.

E.7.6. Numerous historic resouces located on the Bayous Grosse Tete, Lafourche, and Teche natural levee ridges bordering the Atchafalaya Basin have been included in the National Register of Historic Places. These, however, are located outside of the project-affected area.

Section 8 - NATIONAL TRUST PROPERTIES

E.8.1. The only National Trust property in Louisiana is Shadows-on-the-Teche, located on the west bank of Bayou Teche in Iberia Parish. Built during 1831-1834, this was the home of David Weeks, a wealthy planter and landowner. It is a two-story porticoed mansion with eight giant Tuscan columns and a second floor veranda. No major changes have been made in the house since the Civil War. Shadows-on-the-Teche is located outside and west of the project-affected area.

Section 9 - SIGNIFICANT RESOURCE CATEGORIES

E.9.1. Based upon information provided in the previous sections of this report and the guidelines provided in US Army Corps of Engineers regulation entitled, "Environmental Quality: Policy and Procedures for Implementing NEPA," four significant cultural resources categories were identified in the study area. These four categories include National Register Properties, National Trust Properties, Archeological Resources, and Culture of the Basin. The rationale for selection of each of these categories is provided below.

E.9.2. National Register Properties. Historic properties listed or determined eligible for inclusion in the National Register of Historic Places are significant resources by virtue of their National Register status. The National Register of Historic places was established as the key management tool for cultural resource management in 1966 by enactment of the National Historic Preservation Act. This law and the various other Federal mandates that created the cultural resource management field require that all Federal agencies having direct or indirect jurisdiction over Federal or Federally-assisted and licensed activities "take into account" the effects of the proposed undertaking on significant cultural resources. A significant cultural resource is defined by these Federal mandates and the resulting Federal regulations as one that meets the criteria for inclusion in the National Register of Historic Places contained in Title 36 Code of Federal Regulations, Part 60.6.

E.9.3. National Trust Properties. Historic properties of the National Trust for Historic Preservation are considered significant resources, having been identified by this private organization as important resources worthy of preservation.

E.9.4. Archeological Resources. The National Register of Historic Places is the key management tool for identifying significant cultural resources. However, the archeological resources category was included as a significant resource to take into account the archeological resource base in the study area. This was necessary because of the site specific nature of the National Register category and the limited cultural resource survey coverage in the basin.

E.9.5. The destruction and loss of the archeological resource base in this nation has long been a concern of the public and the archeological profession. This fact is evidenced by the Federal mandates of past decades that have established a national policy of enhancement and preservation of cultural resources. It is, therefore, appropriate to consider as a significant resource the known and suspected cultural resource base of the Atchafalaya Basin.

E.9.6. A further reason for inclusion of this category is the incomplete cultural resource survey coverage of the project-affected area. Only the levee raising feature of the alternatives has been subject to intensive survey. Future intensive cultural resources surveys of other features of the selected plan will undoubtedly locate additional cultural resources eligible for inclusion in the National Register. Therefore, to restrict consideration of archeological resources to those presently included in the National Register would not adequately address the impacts of each plan upon cultural resources. This category allows assessment of alternative impacts relative to the resource base in general rather than assessing impacts only upon the few presently identified National Register and Register-eligible properties.

E.9.7. Culture of the Basin. The rationale for selection of this significant resource category includes the expressed public concern over the potential effects of the selected plan upon the traditional culture of the basin. Additional considerations for significant resource designation are the unique nature of the basin's culture, the fragility of this resource, and the great impact upon this resource that could result from implementation of the selected plan. This significant resource category allowed consideration of the culture of the basin during alternative formulation and assessment of alternative impacts.

Section 10 - ALTERNATIVE IMPACT ASSESSMENT

NATIONAL REGISTER PROPERTIES

E.10.1 Plan 4 (EQ)--1980 to 2030. With this plan, the ongoing levee enlargements would possibly affect one National Register property in the basin, 16SM45, and 6 of the sites identified by the cultural resources survey as potentially eligible for inclusion in the National Register. The effects of the levee enlargement feature of this plan upon each of these significant cultural resources is being determined as project design continues. The full impact of this plan upon National Register properties cannot be addressed without the benefit of an intensive cultural resources survey of all the project features. Such a survey will be conducted for all features of the selected plan during the next stage of planning.

E.10.2. Compared to the without-project conditions, this plan would not impact any additional cultural resources presently listed or determined eligible for inclusion in the National Register of Historic Places, since levee enlargement is a feature of the without-project conditions. However, the other project features under this plan would possibly impact additional cultural resources identified by future investigations as eligible for inclusion in the National Register.

E.10.3. Plan 4 (EQ) - 2030 to 2080. Since maintenance of an adequate flowline could necessitate continued levee enlargements during the second half of project life, this plan would possibly impact additional cultural resources eligible for inclusion in the National Register.

E.10.4. Plans 7 (NED) and 9 (Recommended Plan). Same as Plan 4.

NATIONAL TRUST PROPERTIES

E.10.5. Plan 4 (EQ). With this plan there would be no effects upon Shadows-on-the-Teche, the only National Trust property in the study area.

E.10.6. Plan 7 (NED). Same as Plan 4.

E.10.7. Plan 9 (Recommended Plan). Same as Plan 4.

ARCHEOLOGICAL RESOURCES

E.10.8. Plan 4 (EQ)--1980 to 2030. Although the full impact of this plan cannot be determined due to an incomplete data base and the preliminary level of design, the effects can be estimated based upon known site locations and prehistoric and historic settlement information. The ongoing levee enlargement would adversely affect numerous recorded archeological sites, some of which are possibly eligible for inclusion in the National Register.

E.10.9. The environmental easements of this plan would be beneficial to the conservation of archeological resources by placing an easement regulating land clearing and excavation over all property in the basin except developed ridges and state-owned land. Although such an easement would protect cultural resources from unregulated land development, oil and gas exploration would not be restricted and these activities will continue to damage archeological resources. Additionally, the 105,000 acres of public access lands as well as the 1,500 acres of recreational development under the real estate feature would subject archeological resources in these areas to vandalism and pothunting due to increased public access. The creation of management units for enhancement of natural resources would, to some degree, protect archeological resources located within the units by preventing most land alteration. But as with the environmental easements, the continuing oil and gas exploration and increased public access would adversely affect archeological resources in these units. The land alteration related to construction of the management units, recreation development, and other major project features would impact many recorded sites and undoubtedly more presently unrecorded sites.

E.10.10. Compared to the future-without conditions, this plan would prevent the conversion to agriculture of 183,500 acres of forested land in the basin. Thus, this plan would lessen the destruction of archeological sites due to land-use changes. This would be accomplished by restricting development, through environmental easements and mangement units, in undeveloped areas of the basin which, under the future-without conditions, would be subject to unregulated land development as the basin silted in. However, this plan would involve construction impacts related to major project features that are not included in the without-project future. Also, the expanded public access to the basin would increase the incidence of pothunting and vandalism of archeological sites.

E.10.11. Plan 4 (EQ) - 2030 to 2080. During the second half of project life, additional levee enlargement would continue to impact archeological resources located on the edges of the floodway.

E.10.12. Plan 7 (NED) - 1980 to 2030. With this plan, 204,000 acres of presently forested land in the basin would be subject to clearing and conversion to agriculture by the year 2030. Approximately 27,500 acres of this clearing would occur along the natural levees in the backwater area because of the stabilized water levels resulting from the extension of the Avoca Island levee. The unregulated land development that would occur in the basin would result in adverse impacts to scores of archeological resources. Sites presently protected by their location in seasonally flooded areas would be impacted as agricultural and urban expansion followed sedimentation and draining of the swamps. The increased recreational use of the basin due to the acquisition and development of 1,500 acres of recreation lands would subject archeological sites in the basin to vandalism and pothunting. Additionally, construction related to major project features would impact numerous recorded sites.

E.10.13. Compared to the future-without conditions, this plan would be detrimental to archeological resources because it would accelerate the processes of siltation, clearing, and conversion to agriculture. This plan would involve an additional 18,900 acres of clearing over the without-project conditions by the year 2030. This plan would also involve construction impacts related to major project features that are not included in the without-project future. Also, the expanded public access to the basin would increase the incidence of pothunting and vandalism of archeological sites.

E.10.14. Plan 4 (EQ) - 2030 to 2080. During the second half of project life, additional levee enlargement would continue to impact archeological resources located on the edges of the floodway.

E.10.15. Plan 9 (Recommended Plan). Similar to Plan 4.

CULTURE OF THE BASIN

E.10.16. Plan 4 (EQ)--1980 to 2030. With this plan, no extension of the Avoca Island levee is included. Thus, flooding caused by backwater influences on the east of the floodway will become more frequent and to greater depths in relation to the rate of delta development. This could lead to displacement of commercial fishermen and other swamp exploiters currently residing on these natural levees. However, the increasing frequency and depth of backwater flooding could beneficially affect the marine biological productivity of the backwater area and thus, the traditional utilization of the area. The environmental easement and the management units under this plan would serve to enhance the natural resources upon which the economy of the basin's folk culture is based. However, the greatly increased recreational use of the basin above the base condition due to expanded public access and recreational development would bring recreationists into conflict with the existing commercial exploitation of the basin. The disruption of existing access routes and the limited access that would be provided by the management units would affect the traditional exploitation of the basin and cause competition over limited access facilities. The ongoing levee enlargement would continue to displace people in the Henderson Lake and Catahoula areas.

E.10.17. Compared to the future-without conditions, the implementation of this plan would lessen the sedimentation rate and restrict land clearing in the lower basin. The environmental easements would restrict excavation and land clearing over all property in the basin except developed ridges and state-owned property. The five management units would serve to enhance natural resources through control of water regimes. In addition, the sediment control features of this plan would further enhance natural resources. Thus, this plan would slow the deterioration of the natural conditions, which are the bases of the traditional economy of the basin's inhabitants. This would be accomplished by preventing the conversion to agriculture of 183,500 acres of forested land in the basin by the year 2030.

E.10.18. However, the acquisition of 105,000 acres for public access under the Real Estate feature would greatly increase recreational use of the basin's resources beyond the projected future-without conditions. Increased recreational use of the basin would necessarily conflict with established commercial patterns of use. The construction related to the establishment of the five management units would affect the traditional access routes into the basin's interior and cause competition over limited access facilities.

E.10.19. Plan 4 (EQ)--2030 to 2080. During the second half of project life the same processes decribed previously would be expected to continue.

E.10.20. Plan 7 (NED)--1980 to 2030. The siltation, clearing, and conversion to agriculture of 204,000 acres of presently forested land in the floodway and backwater area by 2030 under this plan would have detrimental and far-reaching effects upon the folk culture of the basin. The loss of this natural habitat would result in a concurrent decline in the quantity and quality of the resources available for utilization by the basin's inhabitants. Traditional occupations would necessarily be abandoned in favor of employment in the petroleum and other industries. Folk traditions, adaptive skills, and crafts would be lost in a relatively short time period. The increased recreational use of the basin due to the acquisition and development of 1,500 acres of recreation lands would lead to conflicts between the recreationists and the traditional commercial fishermen over the dwindling resource base. Therefore, deterioration of the resource base and the increased competition from recreational users would adversely and irrevocably impact the folk culture existing in the basin.

E.10.21. Compared to the future-without conditions in the year 2030, this plan would essentially accelerate the processes of siltation and draining of the swamps and would involve the clearing of an additional

18,900 acres of forested land. The increased recreational access to the basin over the future-without conditions would cause conflicts between the recreationists and commercial fishermen over the dwindling resource base.

E.10.22. Plan 7 (NED)--2030 to 2080. During the second half of project life, an additional 25,000 acres of forested land would be subject to land clearing and conversion to agricultural use. This would continue the deterioration of swamp productivity and further disrupt the traditional folk culture.

E.10.23. Plan 9 (Recommended Plan). Similar to Plan 4.

Section 11 - FUTURE CULTURAL RESOURCE REQUIREMENTS

E.11.1. The US Army Corps of Engineers' responsibilities and procedures for identification and administration of historic and cultural properties are outlined by the Advisory Council on Historic Preservation regulations, "Protection of Historic and Cultural Properties," (Final Amendments 36 C.F.R. 800) and US Army Corps of Engineer regulation, "Identification and Administration of Historic Properties." The reader is referred to these regulations for details of the compliance process.

E.11.2. Briefly stated, during the next stage of project planning an intensive cultural resources survey of the entire project impact area will be conducted to determine the number and extent of the resources present. The survey will result in data that is adequate to determine resource eligibility for inclusion in the National Register of Historic Places. Any cultural resource determined eligible for inclusion in the Register and which would be adversely affected by the project would be avoided, protected or, in the absence of a feasible alternative, mitigated by data recovery.

Section 12 - INTERPRETIVE POTENTIAL

E.12.1. The numerous archeological sites and the rich cultural heritage of the Atchafalaya Basin offer great scientific, educational, and interpretive potential. The proposed recreational development plan recognizes this potential by recommending that the project visitor center be located at Bayou Sorrel Mounds (16IV4). The reader is referred to Appendix F, Recreation Resources, of this report for further information.

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APPENDIX F

RECREATION RESOURCES

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RECREATION RESOURCES

F.0.1. This appendix presents basic data, calculations, and detailed considerations employed in analyzing and assessing the existing and potential recreation resources and needs of the project area. It also describes the rationale for proposing a recreational plan of development consistent with planning goals and objectives which are also compatible with other plan features.

Section 1 - INTRODUCTION

F.1.1. The Atchafalaya Basin offers an extensive array of recreational use potentials because of its natural, semi-wilderness setting (see Appendix A). These potentials have been recognized for years.

F.1.2. A preliminary master plan, DM No. 33A, dated April 1967, presenting a plan for construction of 31 access areas in the Atchafalaya Basin Floodway was prepared for the project. The Chief of Engineers by second indorsement, dated 15 September 1967, approved 26 of these areas for detailed planning and deferred the other five pending further consideration. The parish police juries refused the required local cooperation on two sites. Local interests have developed three sites. The Bayou Courtableau control structure was deferred pending decision on location and design of the structure.

F.1.3. A public use plan, DM No. 34, dated August 1972, was subsequently prepared, proposing Federal construction of the remaining 20 access sites that would be locally operated and maintained.

F.1.4. This public use plan was reviewed as part of the overall Atchafalaya Basin study effort contained in this report. In addition, a comprehensive analysis was made of all the basin's recreational resources, with a view toward maximizing public accessibility and use while minimizing adverse impacts on the existing biological and physical environment.

F.1.5. Much of the recreation planning effort was coordinated with representatives of the Agency Management Group to include the many diverse and sometimes conflicting interests in the floodway on a local, state, and national scale, and because of the difficulty in developing a multipurpose program for managing the various features of the project (i.e., flood control, environmental, recreational, cultural, etc.).

F.1.6. Major developmental constraints included the flood-prone nature of the floodway, the extensiveness of privately-owned land, and limited public access. All of these factors influence recreation and natural resource planning and development considerations.

Section 2 - RECREATIONAL DEMAND AND NEED ANALYSIS

OVERVIEW OF METHODS AND OBJECTIVES

F.2.1. A regional analysis approach was used to determine priorities with respect to recreational needs. The approach is a generalized way of presenting recreational supply/demand relationships for land and water use within the project market area and is similar to that used by many states in preparing their Statewide Comprehensive Outdoor Recreation Plan (SCORP).

F.2.2. The analysis had three objectives: first, to determine the demand for 10 water-based and 14 land-based recreational activities within the project market area; second, to translate demands for 17 of these activities into facility needs (demands for the remaining seven activities were not converted into needs because meaningful supply figures for those activities could not be ascertained); and third, to use this information in identifying potentials for recreational and fish and wildlife development in or along the project areas.

F.2.3. The scope of the analysis included 20 south-central Louisiana parishes that encompass the project and form the project market area (Figure F-2-1). Demand and need are projected for target years 1980 and 2030, which span that portion of the project life for which such projections could realistically be made.

F.2.4. Because of the complexity of this analysis and the nonavailability of current, extensive base data, usable information necessary to complete the analysis had to be extrapolated from several sources. Sources and methods of extrapolation will be discussed as the analytical demand equation is detailed.

F.2.5. The complete demand-need determination equation is complex; but viewed in its most simplistic form, it is composed of three elements: demand, supply, and need. Need is defined as that amount remaining when all demand is compared with the existing supply: (demand - supply = need). These three components, in turn, require numerous interim calculations in their respective determinations. They are discussed in the following paragraphs.

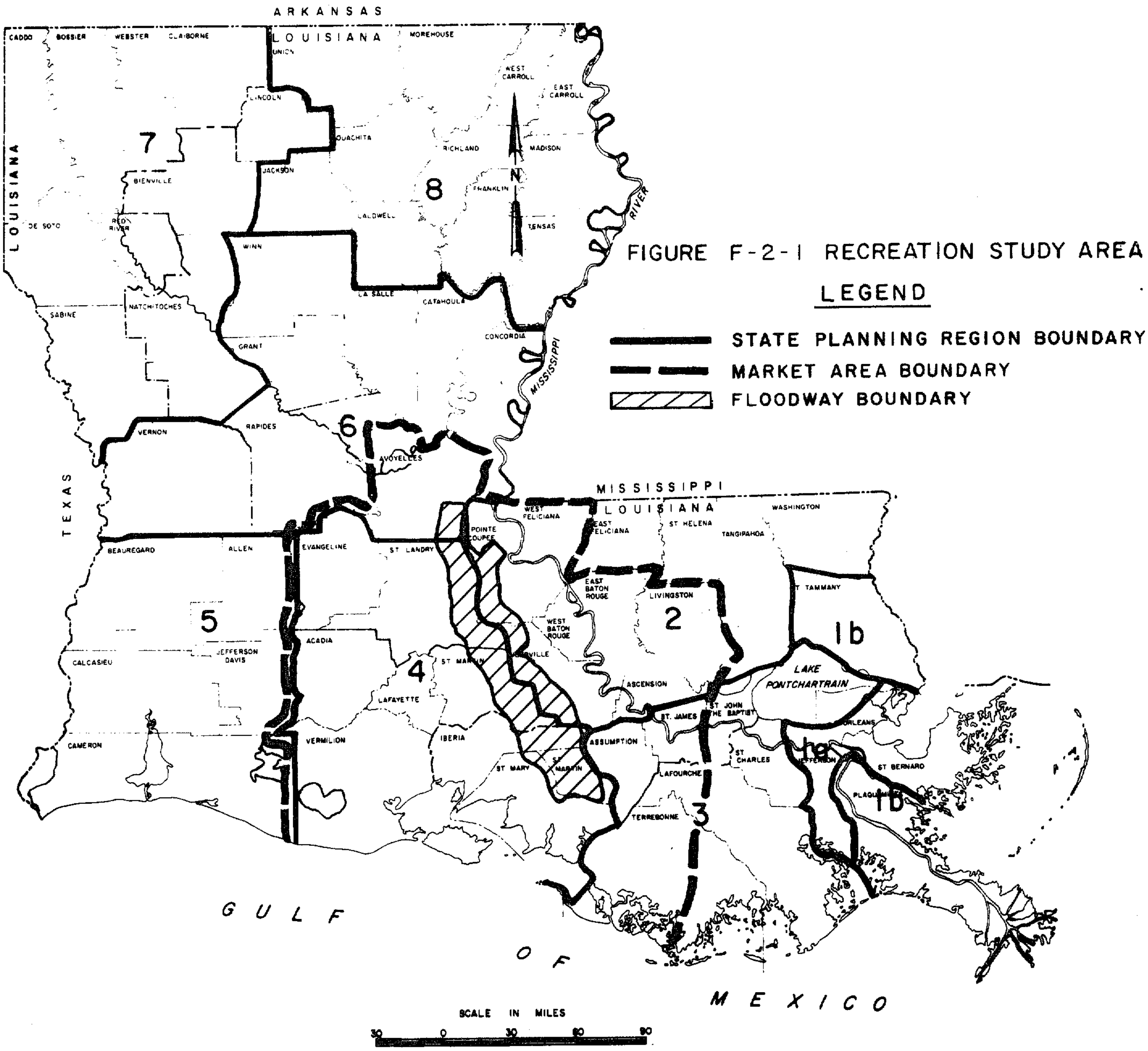
FIGURE F-2-1 RECREATION STUDY AREA
LEGEND
STATE PLANNING REGION BOUNDARY
MARKET AREA BOUNDARY
FLOODWAY BOUNDARY
ARKANSAS
LOUISIANA
MISSISSIPPI
TEXAS
GULF OF MEXICO
LAKE PONTCHARTRAIN
MISSISSIPPI RIVER
SCALE IN MILES

DEMAND

F.2.6. Demand is commonly viewed as an expression of desire to engage in an activity by an individual in a given area. To calculate demand, two essential components must be determined: the market area and its population composition, and the individual participation rate of each activity measured.

F.2.7. "The Plan Formulation and Evaluation Studies - Recreation," Volume II, US Army Corps of Engineers' Institute for Water Resources, postulates that an area that contributes 80 percent of the day-use visitation is defined as the market area. Using this postulate, an analysis of the 1971-1974 "Atchafalaya Basin Usage Study" (US Army Corps of Engineers and Louisiana Department of Wildlife and Fisheries) revealed a primary market influence zone of 45 miles. Thirteen parishes which fell wholly in this zone, together with some interpolative adjustments of seven partial bordering parishes, comprised the market area for the Atchafalaya Recreation Demand-Need Analysis. Additional available data on user characteristics of State Wildlife Management Areas in the market area, which were compiled and analyzed by the US Fish and Wildlife Service, and the Louisiana Department of Wildlife and Fisheries corroborated this market area determination. Parishes which make up the market area and their population projections for 1980 and 2030 are shown in Table F-2-1. Populations for the market area parishes were extracted from Bureau of Economic Analysis and Economic Research Service (OBERS) Projections, Series E 1972, and are shown by parish and the state planning region in which that parish lies.

F.2.8. The 1977 SCORP was used to identify participation rates for each of 21 recreational activity types. Only recreational activities which could be provided on the project were elected from the SCORP for this analysis. The State of Louisiana, through a statewide demand survey, measured high quarter recreational preferences (per capita participation rate) by regions and compared these expressions with the known supply of activities to determine need by activity type. The high quarter participation rates for each activity type were modified during consultation and concurrence by the Louisiana Department of Culture, Recreation and Tourism, through its Office of Program Development. These rates were modified to reflect the determined market area. With the 45-mile radius of the Atchafalaya market area as the outer boundary, Louisiana State Planning Regions 2, 3, 4, and 6 are transected. The adjusted market area participation rates were calculated by determining the proportion of the population of each planning region which lies in the market area, and weighing the market area participation rate by that percentage. This rate reflects the demand of the 45-mile market area with respect to its population as adjusted for both 1980 and 2030.

TABLE F-2-1

ATCHAFALAYA BASIN STUDY MARKET AREA - POPULATION PROJECTIONS BY PARISH AND STATE PLANNING REGIONS FOR 1980 AND 2030

State Planning Region	Parish	1980	2030
2	Ascension	42,446	45,293
	East Baton Rouge	327,291	390,168
	Iberville	31,767	33,898
	Livingston	46,315	49,421
	Pointe Coupee	22,540	24,052
	West Baton Rouge	18,476	19,715
	West Feliciana	8,782	9,371
	Subtotal	497,617	571,918
3	Assumption	20,927	22,331
	Lafourche	38,186	40,747
	St. James	20,099	21,448
	Terrebonne	43,605	46,529
	Subtotal	122,817	131,055
4	Acadia	51,999	44,606
	Evangeline	31,638	27,139
	Iberia	60,843	51,882
	Lafayette	128,487	145,666
	St. Landry	78,812	67,606
	St. Martin	33,628	28,846
	St. Mary	59,526	51,062
	Vermilion	43,499	37,313
	Subtotal	488,432	454,120
6	Avoyelles	37,893	28,715
	TOTAL	1,146,759	1,185,808

F.2.9. Participation rates for hunting activities were supplied by the US Fish and Wildlife Service (USFWS). These rates were determined by first projecting the average number of man-days engaged in by each hunter as recorded in the 1975 USFWS "Hunting and Fishing Survey for Louisiana," then multiplying the average hunter man-days by the number of licensed hunters residing in the market area. The resulting number is expressed as a participation rate of the total population of the market area and can be applied directly to the demand equation.

F.2.10. Once calculated, the market area population and market area participation rates for each activity are multiplied together to yield the gross demand figure for the activity as measured in activity occasions for the high quarter of the year, except for hunting, which is measured by hunting season. These are the periods in which demand is greatest.

F.2.11. Although gross demand in activity occasions was determined according to the basic procedure as outlined, several factors were developed as integral parts of the equation to more realistically define the degree and proportions of demand that can be satisfied within the market area. It is the application of these factors to the equation that reduces gross demand stated in units of activity occasions to net demand stated in units of resource facilities. This transition is necessary to make the ultimate comparison between demand and supply to determine need in facility requirements.

F.2.12. The first adjusting factor is the high quarter day. The high quarter demands were divided by 91.5 days (the number of days in the quarter) to measure the average daily demand that occurs in the peak season of use. A facility use over a year will vary widely; however, by planning for high quarter daily demands, the assumption is made that the facilities provided to satisfactorily accommodate this level of visitation will be more than adequate to handle the visitation that would occur during the remainder of the year. A high quarter day was not calculated for hunting activities because hunting carrying capacities are expressed over a hunting season (its high quarter) on a sustained yield harvest by varying land-use and habitat types.

F.2.13. The facility standard measures that amount of use a facility should receive under optimal conditions. These standards, as applied to the demand equation, are general guides that determine the number of facilities to be developed. The facility standards in the 1977 Louisiana SCORP were modified for use in this study after consultation with and agreement by the Louisiana Department of Culture, Recreation and Tourism, and the US Army Corps of Engineers, to more nearly reflect the type of facility developments that could be expected in the project area. The US Army Corps of Engineers' guidelines, "Heritage, Conservation and Recreation Service (HCRS) Outdoor Recreation Space Standards," and the Texas and Arkansas SCORP standards provided additional sources of comparison in the derivation of the modified facility standards as shown on Table F-2-2.

TABLE F-2-2

FACILITY USE STANDARDS AND MODIFICATIONS

WATER-ORIENTED ACTIVITY STANDARDS

Power boating:
Assume 4 persons/boat/launching lane
Turnover Rate = 16 (Launches and retrievals)
= 64 User-days (ud)/launching lane

Waterskiing:
Assume 4 persons/boat/launching lane
Turnover Rate = 16 (Launches and retrievals)
= 64 ud/launching lane

Nonpower boating:
Assume 2.25 persons/boat/launching lane
Turnover Rate = 16 (Launches and retrievals)
= 36 ud/launching lane

Boatfishing (fresh, salt):
Assume 2.5 persons/boat/launching lane
Turnover Rate = 20 (Launches and retrivals)
= 50 ud/launching lane

Bankfishing (piers):
Assume 1 person/10 linear feet of pier
Turnover Rate = 2
= 2 ud/10 linear feet

Bankfishing (other):
Assume 48 persons/mile of bank
Turnover Rate = 3
= 1 ud/36 linear feet

Crabbing:
Assume 1 person/80 linear feet of right-of-way
Turnover Rate = 1
= 1 ud/80 linear feet

Crawfishing:
Assume 1 person/266 linear feet of right-of-way
Turnover Rate = 1
= 1 ud/266 linear feet

Swimming:
Assume 1 person/9 square yards of water and 9 square yards of land
Turnover Rate = 2
= 2 ud/9 square yards of water and 9 square yards of land

TABLE F-2-2
(Continued)

FACILITY USE STANDARDS AND MODIFICATIONS

WATER ORIENTED ACTIVITY STANDARDS MODIFICATION

The daily time of launch lane use for power boating (Activity A), water skiing (Activity B), and non-power boating (Activity C) is generally from 10:00 a.m. to 6:00 p.m. whereas for boatfishing (Activity D), use occurs generally from 5:30 a.m. to 12:00 noon, and from 4:00 p.m. to 7:30 p.m. Use of launch lanes for Activity D between 12:00 p.m. and 4:00 p.m. is generally nil. During this time frame, launch lane use can be applied to Activities A, B, and C to minimize lanes needed as shown in the following steps:

1. Calculate total lane need for Activity D

2. Calculate total lane need for Activities A, B, and C.
3. Divide total lane need for Activity D by 2 as each lane for Activity D will support one-half of the daily need for Activities A, B, and C. (4 hours of non-use between 12:00 p.m. and 4:00 p.m. by Activity D equals one-half of 8 hours per day needed for Activities A, B, and C.)

4. Subtract the number derived in step 3 from the Activity A, B, and C total need.

5. Add steps 1 and 3 to arrive at total net lane need.

EXAMPLE

Assume 20 lanes needed for Activity D
Assume 10 lanes needed for Activity B
Assume 10 lanes needed for Activity A
Assume 4 lanes needed for Activity C

According to the 5 steps of the formula:
1. 20 lanes
2. 24 lanes
3. 20 lanes ÷ 2 = 10 lanes
4. 24 - 10 = 14 net lanes for Activities A, B, and C
5. 20 + 14 = 34 total lanes needed for all activities combined

LAND-ORIENTED ACTIVITY STANDARDS

Bicycle trails:
Assume 10 persons/trail mile
Turnover rate = 3
= 30 ud/trail mile
Optimum Trail Length = 10 - 15 miles

TABLE F-2-2
(Continued)

FACILITY USE STANDARDS AND MODIFICATIONS

Birdwatching:
Assume 10 persons/trail mile
Turnover rate = 4
= 40 ud/trail mile
Optimum Trail Length = 1/4 - 1 mile

Tent camping:
Assume 4 persons/site
Turnover rate = 1
= 4 ud/site

Trailer camping:
Assume 4 persons/site
Turnover rate = 1
= 4 ud/site

Hiking trail:
Assume 5 persons/trail mile
Turnover rate = 4
= 20 ud/trail mile
Optimum Trail Length = 1 - 5 miles

Horse trails:
Assume 10 persons/trail mile
Turnover rate = 2
= 20 ud/trail mile
Optimum Trail Length = 5 - 20 miles

Nature walk:
Assume 10 persons/trail mile
Turnover rate = 4
= 40 ud/trail mile
Optimum Trail Length = 1/4 - 1 mile

Picnicking:
Assume 3.85 persons/site
Turnover rate = 2
= 7.7 ud/site

Multi-use field:[1/]
Assume 20 persons/game field
Turnover rate = 1.5
= 30 ud/field

[1/]Multi-use fields are used for softball, baseball, soccer, football, and for any other organized or unorganized activity which requires an open field (i.e., frisbee, kite flying, etc.).

TABLE F-2-2
(Continued)

FACILITY USE STANDARDS AND MODIFICATIONS

Multi-use court:
Assume 10 persons/court
Turnover rate = 2
= 20 ud/court

Playground:
One child's playground provides 5,378 days[2/] of opportunity per year.
0.53 = percent of total use which occurs in the summer
Then: 5,378 x .53 = 2,850.34 ÷ 91.5 days in the quarter = 31.15
= 31 ud/playground

[2/] Texas SCORP

F.2.14. Applying the preceeding adjustment factors, demand in activity occasions can now be expressed in average high-quarter day demand by resource or facility units for all activities except hunting, which will be expressed in man-days.

F.2.15. Demand in itself is a general expression and its specific associations to the market area can be vague unless properly defined. Two additional factors to accomplish this task were developed.

F.2.16. One factor relates to public versus private satisfaction of demand. Demand responses in the 1977 SCORP demand survey do not account for the level of an activity which will occur at exclusive sites not open to the public, even for a fee, such as private swimming pools or tennis courts at apartment complexes that are available to the tenants. This type of facility does satisfy some demand. The degree of demand satisfaction should be apportioned to determine the demand for public facilities. In this study effort, each activity was analyzed to determine the percent or level of demand which should then be satisfied by public facilities development. These percentages are shown in Tables F-2-3 and F-2-4. It should be remembered that both the demand for and supply of such facilities does not necessitate public ownership but includes those commercial operations that are available to the public on a fee (commercial) basis.

F.2.17. Not all recreation demand can or should be satisfied within a particular market area for several reasons. The public has diverse recreational interests and tends to satisfy its recreational demands at various locations that may be near or distant from the place of origin. In addition, certain recreational pursuits may be engaged in only where the source of supply exists, such as on larger water bodies for deep sea fishing or in the mountains for snow skiing. As a result, a factor was designed to measure the amount of demand that should be provided to satisfy the potential user within a geographic context. By analyzing each activity, respective percentages were derived that would reduce overall demand levels to that amount which is desired and could be satisfied in the market area, and not elsewhere in the State of Louisiana or elsewhere in the United States. These percentages are shown in Tables F-2-3 and F-2-4.

F.2.18. Conversely, a factor to measure the demand from outside the market area to be met in the market area was applied to the demand equation. This beyond the market area factor is based upon the original postulate that the market area population contributes only 80 percent of the total demand. The 20 percent beyond the market area factor is represented as 0.8 in Tables F-2-3 and F-2-4.

TABLE F-2-3

ATCHAFALAYA BASIN STUDY
RECREATION DEMAND - NEED EQUATION
YEAR 1980

Activity Type	Market Area 1980 Population	Market Area Participation Rate	Market Area High Quarter Activity Occasions	Market Area Days In High Quarter	Market Area High Quarter Day	Facility Standard	Gross Market Demand	Percent to Be Met In Market Area	Percent to Be Met In Public Area	Beyond Market Area Factor	Net Market Demand	Market Area Supply	Net Market Area Need
Land-Oriented													
1. Bicycling	1,146,759	7.77	8,910,317	91.5	97,381	30 ud/trail Mile trail length 10-15 mi.	3,246	50	99	0.8	2,008	0.85	2,007.15 trail miles
2. Birdwatching	1,146,759	2.17	2,488,467	91.5	27,196	40 ud/trail Mile trail length 1-5 mi.	680	85	36	0.8	260		
3. Camping, tent	1,146,759	3.19	3,658,161	91.5	39,980	4 ud/site	9,995	90	55	0.8	6,184	411	5,773 sites
4. Camping, trailer	1,146,759	1.04	1,192,629	91.5	13,034	4 ud/site	3,259	85	55	0.8	1,904	2,616	-712 sites
5. Hiking	1,146,759	1.06	1,215,565	91.5	13,285	20 ud/trail Mile trail length - 4 mi	664	100	70	0.8	581	10.5	570.5 trail miles
6. Horseback riding	1,146,759	1.35	1,548,125	91.5	16,919	20 ud/trail Mile trail length - 6 mi.	846	85	95	0.8	854	4	850 trail miles
7. Nature walk	1,146,759	1.96	2,247,648	91.5	24,564	40 ud/trail Mile trail length - 1 mi.	614	95	90	0.8	656	28.8	627.2 trail miles
8. Picnicking	1,146,759	2.30	2,637,546	91.5	28,826	7.7 ud/site	3,744	85	85	0.8	3,381	2,704	677 sites
9. Multi-use field	1,146,759	3.41	3,910,448	91.5	42,737	30 ud/field	1,425	95	99	0.8	1,675	796	879 fields
10. Multi-use court	1,146,759	2.62	3,004,509	91.5	32,836	20 ud/court	1,642	50	99	0.8	1,016	709	307 courts
11. Sightseeing	1,146,759	7.22	8,279,600	91.5	90,487	None	-	65	35	0.8	-	-	-
12. Playground	1,146,759	2.00	2,293,518	91.5	25,066	31 ud/playground	809	100	99	0.8	1,001	259	742 playgrounds
Water-Oriented													
1. Boating, power	1,146,759	5.84	6,697,073	91.5	73,192	64 ud/lane	1,144	60	80	0.8	686 (416)[1/]	96	320 lanes
2. Boating, nonpower	1,146,759	0.33	378,430	91.5	4,136	36 ud/lane	115	90	40	0.8	52 (32)[1/]	7	25 lanes
3. Boatfishing, fresh	1,146,759	5.24	6,009,017	91.5	65,672	50 ud/lane	1,313	60	70	0.8	689	242	447 lanes
4. Boatfishing, salt	1,146,759	2.39	2,740,754	91.5	29,954	50 ud/lane	559	60	70	0.8	90		
5. Bankfishing, fresh	1,146,759	1.03	1,181,161	91.5	12,909	2 ud/10 lin. ft. pier 1 ud/36 lin. ft. bank	64,545 464,724	85	85	0.8	58,293 pier 419,704 bank		
6. Crabbing	1,146,759	2.03	2,327,921	91.5	25,442	1 ud/80 lin. ft.	385 mi.	90	50	0.8	217		
7. Crawfishing	1,146,759	2.45	2,809,560	91.5	30,706	1 ud/266 lin. ft.	1,547 mi.	90	95	0.8	1,653		
8. Swimming, lake	1,146,759	1.50	1,720,139	91.5	18,799	2 ud/9 sq. yds. land and water	169,192 sq. yds.	90	99	0.8	1,586,167 sq. feet	1,643,468	-57,301 sq. feet
9. Waterskiing	1,146,759	1.13	1,295,838	91.5	14,162	64 ud/lane	221	60	80	0.8	132 (79)[1/]	18	61 lanes

[1/] Boat lanes demanded as shown in parentheses represent a more refined, weighted demand that represents overlapping use for related activities, as explained in Facility Use Standards and Modifications (Table F-2-2).

TABLE F-2-4

ATCHAFALAYA BASIN STUDY
RECREATION DEMAND - NEED EQUATION
YEAR 2030

Activity Type	Market Area 2030 Population	Market Area Participation Rate	Market Area High Quarter Activity Occasions	Market Area Days In High Quarter	Market Area High Quarter Day	Facility Standard	Gross Market Demand	Percent to Be Met In Public Area	Percent to Be Met In Market Area	Beyond Market Area Factor	Net Market Demand	Market Area Supply	Net Market Area Need
Land-Oriented													
1. Bicycling	1,185,808	7.79	9,237,444	91.5	100,956	30 ud/trail mile trail length 10-15 mi.	3,365	50	99	0.8	2,082	0.85	2,081.15 trail miles
2. Birdwatching	1,185,808	2.31	2,739,216	91.5	29,937	40 ud/trail mile trail length 1-5 mi.	748	85	36	0.8	286		
3. Camping, tent	1,185,808	3.06	3,628,572	91.5	39,657	4 ud/site	9,914	90	55	0.8	6,135	411	5,724 sites
4. Camping, trailer	1,185,808	1.06	1,256,956	91.5	13,737	4 ud/site	3,434	85	55	0.8	2,006	2,616	-610 sites
5. Hiking	1,185,808	1.02	1,209,524	91.5	13,219	20 ud/trail mile trail length - 4 mi.	661	100	70	0.8	578	10.5	567.5 trail miles
6. Horseback riding	1,185,808	1.32	1,565,267	91.5	17,107	20 ud/trail mile trail length - 6 mi.	855	85	95	0.8	719	4	715 trail miles
7. Nature walk	1,185,808	2.03	2,407,190	91.5	26,308	40 ud/trail mile	658	95	90	0.8	703	28.8	674.2 trail miles
8. Picnicking	1,185,808	2.32	2,751,075	91.5	30,066	7.7 ud/site	3,905	85	85	0.8	3,527	2,704	823 sites
9. Multi-use field	1,185,808	3.58	4,245,193	91.5	46,396	30 ud/field	1,547	95	99	0.8	1,819	796	1,023 fields
10. Multi-use court	1,185,808	2.70	3,201,681	91.5	34,991	20 ud/court	1,750	50	99	0.8	902	709	193 courts
11. Sightseeing	1,185,808	7.26	8,608,966	91.5	94,087	None	-	65	35	0.8	-	-	-
12. Playground	1,185,808	2.06	2,442,764	91.5	26,697	31 ud/playground	861	100	99	0.8	1,066	259	807 playgrounds
Water-Oriented													
1. Boating, power	1,185,808	5.59	6,628,667	91.5	72,444	64 ud/lane	1,132	60	80	0.8	679 (399)1/	96	303 lanes
2. Boating, nonpower	1,185,808	0.30	355,742	91.5	3,888	36 ud/lane	108	90	40	0.8	49 (49)1/	7	42 lanes
3. Boatfishing, fresh	1,185,808	5.26	6,237,350	91.5	68,168	50 ud/lane	1,363	60	70	0.8	716	242	474 lanes
4. Boatfishing, salt	1,185,808	2.30	2,727,358	91.5	29,807	50 ud/lane	596	60	20	0.8	90		
5. Bankfishing, fresh	1,185,808	1.00	1,185,808	91.5	12,960	2 ud/10 lin. ft. pier 1 ud/36 lin. ft. bank	64,800 466,560	85	85	0.8	58,522 pier 421,363 bank		
6. Crabbing	1,185,808	1.96	2,324,184	91.5	25,401	1 ud/80 lin. ft.	385	90	50	0.8	217		
7. Crawfishing	1,185,808	2.36	2,798,507	91.5	30,585	1 ud/266 lin. ft.	1,540	90	95	0.8	1,646		
8. Swimming, lake	1,185,808	1.49	1,766,854	91.5	19,310	2 ud/9 sq. yds. land and water	173,790	90	99	0.8	1,742,027	1,643,468	98,559 sq. feet
9. Waterskiing	1,185,808	1.11	1,316,247	91.5	14,385	64 ud/lane	225	60	80	0.8	135 (76)1/	18	58 lanes

1/Boat lanes demanded as shown in parentheses represent a more refined, weighted demand that represents overlapping use for related activities, as explained in Facility Use Standards and Modifications (Table F-2-2).

F.2.19. By employing all the aforementioned applied factors, gross demand has been translated into a net figure that measures demand for public outdoor recreational facilities by all individuals who live in or travel into the market area to recreate.

SUPPLY

F.2.20. Market area supply data used in the demand need analysis were obtained from two basic sources: the Louisiana SCORP "1980 Recreational Inventory" and "Land Use Projections," which were cooperatively prepared by the USFWS and Louisiana Department of Wildlife and Fisheries.

F.2.21. The Louisiana SCORP provided both public and commercial supply data for recreational activities other than hunting. Market area supply data, in the form of recreational resources by facility type (i.e., picnic site, campsite, boat launch lane), were available for 15 recreational activities. Supply data for seven activities, which included saltwater fishing, freshwater bankfishing, crabbing, crawfishing, birdwatching, sightseeing, and waterfowl hunting, were not available, but an expressed demand for these activities was reflected in the Louisiana SCORP Demand Survey. Supply data for 2030 could not be forecast for nonconsumptive recreational activities. Existing supply figures were used to calculate future needs.

F.2.22. Both public and private hunting supply data were projected in terms of existing and future land use (Tables F-2-5 and F-2-6). Huntable acreage by major habitat type for each parish in the market area was converted to man-days of supply, based upon habitat carrying capacities (biological harvest rate) in man-days per acre (Tables F-2-7 and F-2-8). The conversion to man-days of supply with respect to hunting was to facilitate the translation of the final need figures into acreage requirements for any of the 10 habitat types available for public use.

F.2.23. Large numbers of migratory waterfowl overwinter in the market area; but, because of their mobility, these birds could overwinter in suitable habitat that is presumably available elsewhere. Wintering habitat was not assumed to be a factor limiting migratory waterfowl hunting opportunities. Furthermore, the recognized inclination of waterfowl hunters to travel great distances in pursuit of this form of recreation negates the possibility of using the concept (previously described) of satisfying a given percentage of the demand within the market area. Wood ducks and mottled ducks, however, commonly nest in the market area and any fluctuation in available breeding habitat is expected to directly influence these species and the harvestable surplus that could be produced in the market area. Any gain or loss of habitat would cause a fluctuation in the harvestable population of

TABLE F-2-5

ATCHAFALAYA BASIN STUDY
SUPPLY ACREAGE - MARKET AREA
ALL HABITAT TYPES - YEAR 1980

Habitat Type	Public (Acres)	Private (Acres)	Total (Acres)
Bottomland Hardwoods	145,000	1,187,890	1,332,890
Cypress-Tupelo	0	1,000,145	1,000,145
Upland Pine	0	37,100	37,100
Cottonwood/Willow/ Sycamore	65,000	27,045	92,045
Pine	0	475,200	475,200
Cleared Land	0	2,439,481	2,439,481
Fresh Marsh	20,500	413,739	434,239
Intermediate Marsh	0	138,640	138,640
Brackish Marsh	0	302,977	302,977
Saline Marsh	0	118,751	118,751

The land change rate used to calculate marsh habitat type acreages in the recreational demand-need analysis was updated subsequent to this analysis but the total impact of not using that updated rate is less than 1/10 of 1 percent.

TABLE F-2-6

ATCHAFALAYA BASIN STUDY
SUPPLY ACREAGE - MARKET AREA
ALL HABITAT TYPES - YEAR 2030

Habitat Type	Public (Acres)	Private (Acres)	Total (Acres)
Bottomland Harwoods	157,000	542,845	699,825
Cypress-Tupelo	0	763,055	763,055
Upland Pine	0	37,100	37,100
Cottonwood/Willow/ Sycamore	53,000	2,290	55,290
Pine	0	475,200	475,200
Cleared Land	0	3,309,636	3,309,636
Fresh Marsh	46,964	405,687	452,651
Intermediate Marsh	0	114,253	114,253
Brackish Marsh	0	266,820	266,820
Saline Marsh	0	56,912	56,912

The land change rate used to calculate marsh habitat type acreages in the recreational demand-need analysis was updated subsequent to this analysis but the total impact of not using that updated rate is less than 1/10 of 1 percent.

The total supply acreage loss which occurs from 1980 to 2030 can be attributed to marsh converting to open water as a result of subsidence, saltwater intrusion and curtailment of sediment flow which renourishes the marshes.

TABLE F-2-7

ATCHAFALAYA BASIN STUDY
MARKET AREA MAN-DAYS OF HUNTING SUPPLY
(Man-days/Acre x Acres = Man-days) by
ACTIVITY TYPE FOR ALL HABITAT TYPES - YEAR 1980

Habitat Type	Big Game (public)	Big Game (private)	Small Game (public)	Small Game (private)	Waterfowl[1/] (public)	Waterfowl[1/] (private)
Bottomland Hardwoods	78,155	248,269	34,655	199,566	725	3,564
Cypress-Tupelo	0	77,102	0	72,010	0	5,001
Upland Pine	0	5,565	0	3,562	0	74
Cottonwood/Willow/ Sycamore	13,585	3,354	6,435	1,460	520	81
Pine	0	58,925	0	39,917	0	475
Cleared Land	0	0	0	102,458	0	0
Fresh Marsh	349	7,034	2,235	45,098	41	827
Intermediate Marsh	0	1,109	0	15,112	0	416
Brackish Marsh	0	0	0	22,117	0	303
Saline Marsh	0	0	0	2,850	0	0
Total	92,089	401,268	43,325	504,150	1,286	10,741

[1/] Resident Waterfowl Production Capacity - the estimated number of waterfowl produced per acre per year by habitat type and expressed as man-days/acre of hunting capacity.

TABLE F-2-8

ATCHAFALAYA BASIN STUDY
MARKET AREA MAN-DAYS OF HUNTING SUPPLY
(Man-days/Acre x Acres = Man-days) by
ACTIVITY TYPE FOR ALL HABITAT TYPES - YEAR 2030

Habitat Type	Big Game (public)	Big Game (private)	Small Game (public)	Small Game (private)	Waterfowl[1/] (public)	Waterfowl[1/] (private)
Bottomland Hardwoods	84,623	113,450	37,523	91,195	785	1,628
Cypress-Tupelo	0	58,755	0	54,940	0	3,815
Upland Pine	0	5,565	0	3,562	0	74
Cottonwood/Willow/ Sycamore	11,077	284	5,247	124	265	7
Pine	0	58,925	0	39,917	0	475
Cleared Land	0	0	0	139,005	0	0
Fresh Marsh	798	6,897	5,119	44,220	94	811
Intermediate Marsh	0	914	0	12,454	0	343
Brackish Marsh	0	0	0	19,478	0	267
Saline Marsh	0	0	0	1,366	0	0
Total	96,498	244,790	47,889	406,261	1,144	7,420

[1/] Resident Waterfowl Production Capacity - the estimated number of waterfowl produced per acre per year by habitat type and expressed as man-days/acre of hunting capacity.

these species and in the supply of recreational opportunity associated with this harvestable segment (D. Soileau, USFWS, personal communication). Accordingly, the gain or loss in recreational potential from these species was computed and is measured in man-days of supply as shown in Tables F-2-7 and F-2-8.

NEEDS

F.2.24. Market area needs were obtained by subtracting the market area supply for each recreational activity type from the net market area demand for each recreational activity type. A positive net need indicates that recreational development to accommodate existing and future use is justifiable on the basis of demand and warrants consideration. In the case of the seven recreational activities where demand is expressed but no supply figure could be ascertained, minimal development for that activity type can be considered. A negative need indicates a market area surplus, and careful consideration should be exercised in providing similar additional facilities.

F.2.25. Needs for all recreational activities other than hunting have been stated in terms of recreational resource facility needs. Hunting needs for big game and small game hunting have been stated in terms of bottomland hardwood acreage because this is the prime habitat type for both big and small game species, and as such would offer the highest use capability. It should be pointed out, however, that a conversion to need acreage figures for any habitat type can be easily accomplished by dividing man-days of need (Tables F-2-9 and F-2-10), by the respective habitat carrying capacity (Table F-2-11).

F.2.26. It should be noted that a needs analysis is intended to ascertain general supply-demand relationships for the project market area. The analysis was regional in nature and was intended as a tool to identify alternative types of facility development possibilities for the project. It should not be inferred that all needs for the parishes in the market area be met at the project, which, of course, would ignore needs in other portions of these parishes.

SUMMARY

F.2.27. The needs analysis of the market area shows an overall deficit in recreational needs for all land and water-based recreational activities considered except recreational vehicle or trailer camping, which exhibit a market area surplus. This surplus is predicated on within-state usage and may require additional considerations for minimum facility development based upon the increasing national attraction to the project.

TABLE F-2-9

ATCHAFALAYA BASIN STUDY
RECREATION DEMAND - NEED EQUATION FOR HUNTING ACTIVITIES
YEAR 1980

Activity Type	Market Area Population	Market Area Participation Rate	Percent to be met in Market Area	Beyond Market Area Factor	Percent to be met in Public Area	Percent to be met in Private Area	Gross Market Demand in Man-days	Public Supply in Man-days	Private Supply in Man-days	Public Need in Man-days	Private Need in Man-days	Hunting Carrying Capacity Bottomland Hardwoods	Acres of Net Market Area Need Bottomland Hardwoods
Big Game, public	1,146,759	0.635	81	0.8	34.1		251,417	92,089		159,328		0.539	295,599
Big Game, private	1,146,759	0.635	81	0.8		65.9	485,877		401,268		84,609	0.209	404,828
Small Game, public	1,146,759	1.154	85	0.8	41.6		584,925	43,325		541,600		0.239	2,266,109
Small Game, private	1,146,759	1.154	85	0.8		58.4	821,145		504,150		316,995	0.168	1,886,875

TABLE F-2-10

ATCHAFALAYA BASIN STUDY
RECREATION DEMAND - NEED EQUATION FOR HUNTING ACTIVITIES
YEAR 2030

Activity Type	Market Area Population	Market Area Participation Rate	Percent to be met in Market Area	Beyond Market Area Factor	Percent to be met in Public Area	Percent to be met in Private Area	Gross Market Demand in Man-days	Public Supply in Man-days	Private Supply in Man-days	Public Need in Man-days	Private Need in Man-days	Hunting Carrying Capacity Bottomland Hardwoods	Acres of Net Market Area Need Bottomland Hardwoods
Big Game, public	1,185,808	0.635	81	0.8	34.1		259,979	96,498		163,481		0.539	303,304
Big Game, private	1,185,808	0.635	81	0.8		65.9	502,422		244,790		257,632	0.209	1,232,689
Small Game, public	1,185,808	1.154	85	0.8	41.6		604,843	47,889		556,954		0.239	2,330,351
Small Game, private	1,185,808	1.154	85	0.8		58.4	849,106		406,261		442,845	0.168	2,635,982

TABLE F-2-11

ATCHAFALAYA BASIN STUDY
HUNTING CARRYING CAPACITIES - MARKET AREA
ALL HABITAT TYPES IN MAN-DAYS/ACRE

Habitat Type	Big Game (public)	Big Game (private)	Small Game (public)	Small Game (private)	Waterfowl[1/] (public)	Waterfowl[1/] (private)
Bottomland Hardwoods	0.539	0.209	0.239	0.168	0.005	0.003
Cypress-Tupelo	0.113	0.077	0.072	0.072	0.006	0.005
Upland Pine	0.249	0.150	0.124	0.096	0.002	0.005
Cottonwood/Willow/ Sycamore	0.209	0.124	0.099	0.054	0.005	0.003
Pine	0.207	0.124	0.139	0.084	0.001	0.001
Cleared Land	0.252	0	0.154	0.042	0.002	0
Fresh Marsh	0.017	0.017	0.109	0.109	0.002	0.002
Intermediate Marsh	0.008	0.008	0.109	0.109	0.003	0.003
Brackish Marsh	0	0	0.073	0.073	0.001	0.001
Saline Marsh	0	0	0.024	0.024	0	0

1/ Resident Waterfowl Production Capacity - the estimated number of waterfowl produced per acre per year by habitat type and expressed as man-days/acre of hunting capacity.

F.2.28. Market area recreation demand and usage patterns appear to be closely associated with the existing resource base and the more traditional uses or recreational activities that occur on that resource (i.e., fishing and hunting).

F.2.29. The large amounts of privately-owned land do provide for much of the hunting activity in the market area; however, it is difficult to assess the degree of use and demand satisfaction that they provide.

F.2.30. Water-based recreation provides the greatest potential for use in the market area. Fishing, crawfishing, and crabbing are additional examples of traditional recreational activities that are popularly pursued and which are not as restricted by access. Existing facilities to accommodate water-oriented recreational activities are limited. Many facilities are in poor condition or lacking, particularly well located, developed boat-launching ramps.

F.2.31. There are several nature-oriented activities that have increased in national popularity in recent years. The pursuit of many of these activities, which includes hiking, backpacking, nature study, wildlife photography, and birdwatching, is minimized in the basin because of limited access caused by extensive private land ownership, the relative nonavailability of public land, and the lack of developed support facilities. These are the major problems that have adversely impacted the Atchafalaya Basin and reduced its viability in satisfying both the land and water-based recreational demands of the public.

Section 3 - RECREATION DEVELOPMENT PLAN

OVERVIEW OF TENTATIVELY SELECTED AND RECOMMENDED PLANS

F.3.1. The recommended recreation plan for the Atchafalaya Basin Study has been developed with two main objectives:

- Optimize public accessibility and use of the floodway

- Minimize adverse impacts on the existing biological and physical environment.

F.3.2. The multipurpose nature of the project affords the opportunity to provide for public recreational facility development; however, certain inherent constraints within the floodway prevent optimized development. Among the most significant constraints are the flood-prone nature of the basin, the dispersed local population, the limited vehicular access, and extensive private landholdings. Adding to these constraints is the degree to which a local sponsor would be willing and able to ultimately operate and maintain any developed recreational facilities.

F.3.3. With these objectives and constraints considered, a plan was developed that would satisfy a proportion of the public demand for outdoor recreation within the project market area and yet minimize overall land acquisition and development within the floodway.

F.3.4. The initially developed recreation features of the tentatively selected (TS) plan described in this appendix relied heavily on acquisition of public access easements in the basin. Subsequent to the July 1981 public meetings, an alternative proposal was formulated by the State of Louisiana which, if implemented, would comparably replace the public access feature of the TS plan to which public objections were raised. This feature has been analyzed and is recommended in lieu of that feature of the TS plan. Both plans are presented in this appendix in order to provide a degree of continuity in the various stages of report preparation and to further serve in providing a basis of comparison. A description of the recommended plan is detailed in paragraphs F.3.11. through F.3.16. A comparative analysis of the effects of this alternative feature in terms of annual use and recreation benefits is provided at the end of Sections 5 and 6 of this appendix.

THE TENTATIVELY SELECTED PLAN

F.3.5. The TS plan proposed the combined use of fee purchase and comprehensive multipurpose easement to guarantee public access to about 40 percent of the floodway's acreage. This includes access to approximately 150,000 acres already in public ownership and to an additional 105,000 acres to which access would be acquired under this plan. Such access would increase the viability of public recreational use of the floodway, which has previously been minimal when compared with private use.

F.3.6. In general, the classification and/or use of the 105,000 acres considered for access under the TS plan is summarized as follows:

50,000	Acres of cypress-tupelo
30,000	Acres of bottomland hardwoods
23,000	Acres of greenbelts
500	Acres of rookeries
1,500	Acres of campgrounds, boat launching areas, and special and unique areas
105,000	Total acres to which access would be acquired.

F.3.7. The 50,000 acres of cypress-tupelo would be preserved and maintained in as near a natural state as possible. Development would be minimal. Access would allow the public to view the beauty and uniqueness of this wilderness swamp, which is its greatest attraction. Cypress-tupelo swamps have the potential to support recreational activities, such as wildlife observation, nature study, and canoeing. Hunting also would be allowed, although its potential is greater in the hardwood areas.

F.3.8. The 30,000 acres of bottomland hardwoods would serve primarily as public hunting areas. No major development is envisioned for these areas. In addition to providing for various types of hunting, public access to these lands would offer opportunities for nonconsumptive recreation, such as hiking or nature study.

F.3.9. Greenbelts encompassing 23,000 acres would provide access to land areas for recreational purposes along 300-foot wide strips on each side of public navigable waters and to selected land areas inside and adjacent to floodway protection levees, which are one-fourth mile or less from the water. Aside from protecting the esthetics and enhancing the natural outdoor experience by providing scenic buffers, these greenbelts would allow members of the public to pursue such activities as crawfishing, bankfishing, making overnight canoe trips, hiking, and camping. The flood-prone nature of these greenbelt areas precludes most recreational facilities developments; however, some facilities may be provided in designated areas less susceptible to flooding.

F.3.10. Rookeries are important because they serve as sanctuaries and propagation areas for many exotic bird species found in the basin floodway. These sensitive areas, totaling 500 acres, would only be accessible on a very limited and controlled basis to recreationists who watch and photograph birds. Hunting would be restricted, and other forms of recreation would be subordinated to maintain the integrity and viability of the bird population.

THE RECOMMENDED PLAN

F.3.11. The recommended real estate plan which includes the amended public access feature proposal, utilizes fee purchase and donation to guarantee public access to about 39 percent of the floodway's acreage. This includes access to approximately 150,000 acres already in public ownership and to an additional 79,500 acres to which access would be acquired under this plan. Such access would increase public recreational use of the floodway, which has previously been minimal when compared with private use. Additionally, there are some 10,000 acres located east of the floodway to which access would be acquired under this plan but which are not comparatively analyzed or evaluated in the context of this study.

F.3.12. In general, the classification and/or use of the 79,500 acres under consideration for access is summarized as follows:

12,000	Acres of cypress-tupelo
48,000	Acres of bottomland hardwoods
18,000	Acres of early successional bottomland hardwoods
1,500	Acres of campgrounds, boat launching areas, and special and unique areas
79,500	Total acres to which access would be acquired.

F.3.13. The 12,000 acres of cypress-tupelo would be preserved and maintained in as near a natural state as possible. Development would be minimal. Access would allow the public to view the beauty and uniqueness of this wilderness swamp, which is its greatest attraction. Cypress-tupelo swamps have the potential to support recreational activities such as wildlife observation, nature study, and canoeing. Hunting also would be allowed, although its potential is greater in the hardwood areas.

F.3.14. The 48,000 acres of late successional bottomland hardwoods and 18,000 acres of early successional bottomland hardwoods would serve primarily as public hunting areas. No major development is envisioned for these areas. In addition to providing for various types of hunting, public access to these lands would offer opportunities for nonconsumptive recreation, such as hiking or nature study.

F.3.15. Major recreational facility development would be provided on 1,500 acres of land purchased in fee, either in or near the floodway.[1/] The recommended use of the 1,500 acres is summarized as follows:

3	Developed campgrounds	600 acres
7	Primitive campgrounds	350 acres
1	Project visitor center	100 acres
8	Boat launching ramps (2 lanes)	80 acres
7	Boat launching ramps (5 lanes)	70 acres
1	Nature-interpretive trail	100 acres
	Special and unique areas	200 acres.

F.3.16. The acquisition and development of these areas would accommodate and support additional public use of the basin, provide for additional entry into the floodway and access to its resources, and protect and aid in interpreting specific environmentally and culturally significant resources.

FACILITY DESIGN CRITERIA

F.3.17. General. The number and types of facilities recommended for the various recreational areas are based principally on the projected recreational needs and the appropriateness of the facilities for the specific sites. Projected recreational use served as guides to the number of facilities rather than absolute dictates. The intent was to optimize anticipated recreational benefits while minimizing operation and maintenance costs. The design criteria are a composite of pertinent criteria in Engineering Regulation 1110-2-400, Engineering Manual 1110-2-400[2/], Louisiana State Parks Planning Guidelines, and the Red River Waterway Master Plan for Resources Development.

F.3.18. Siting. For each of the recreational facilities, the most advantageous locations were sought in view of site conditions and recreational needs. The intent has been to avoid construction limitations and environmental impacts, while simultaneously maximizing recreational opportunities.

F.3.19. Frequent low-level flooding is a major siting limitation at nearly all recreation sites. Consequently, potentially affected

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[1/]Recreational facility development as stated is a recommended feature of all plan alternatives.
[2/]This Engineering Manual is currently under revision; however, at the time of this report the revised edition was not available.

facilities would be located above the 10-year flood level where possible. Structures located within the 100-year flood plain would be flood-proofed or designed of materials that can be easily cleaned and restored to operation after flooding. Sedimentation patterns are major constraints in the delineation of sites, as well as the specific location of boat-launching ramps. Other limitations are considered minor and would be mitigated during detailed siting construction.

F.3.20. Camping Areas. More than one type of camping would be provided in or near the floodway. Developed camping, which accommodates both tents and trailers, would require utility services and sanitary facilities. Primitive camping would require very little development. Specific requirements for developed and primitive camping are discussed subsequently.

F.3.21. Developed Camping. This is discussed as follows:

- Location

  Eastern solar exposure is preferable
  Isolated from rest of the recreation area.

- Layout

  Fifty site minimum facility, 100-200 sites desirable
  Five camping units per acre maximum
  Three hundred to 500 feet maximum distance to washhouse.

- Facilities

  RV impact pad and tent camping pad per unit with electrical hook-up
  Picnic table per unit, some designed for access by handicapped
  Fireplace or fire ring per unit
  Charcoal brazier per unit
  Parking space 10 by 25 feet minimum per unit
  Thirty-gallon anchored trash receptacle per two units
  Camping spurs, paved
  Water hydrants and fountain per 25 units
  Washhouse per 50 units
  One heated washhouse for winter use
  One well per 25 units within 300 feet of site where water system is not available
  Sanitary waste dumping station per 50 to 200 spaces
  All night lighting of sanitary facilities
  Water supply: for showers, 100 gallons per day per campsite; for toilets, 60 gallons per day per campsite; for drinking, 20 gallons per day per campsite.

F.3.22. Primitive Camping. Primitive camping areas would accommodate overnight use by canoeists and hikers at designated locations that are isolated. This would be accomplished by providing a limited number of areas having difficult access at remote locations, which are situated in an extensive high-quality natural setting along specific navigable streams.

- Location

  Large areas with high quality natural character
  Isolated location
  May include remote sites accessible by boat or trail only.

- Layout

  Fifty or less campsites desirable
  Two units per acre maximum
  Minimum of 100 feet between units
  Three to eight people per site.

- Facilities

  Central parking at trailhead or boat launch
  Fire circle per unit
  Trash receptacle at trailhead or boat launch
  Vault-type comfort station on site where feasible and/or when use dictates
  Hand pump well on site where feasible.

F.3.23. Day-Use Picnic Areas. Separate picnic facilities would be provided near the developed campgrounds and at specific boat launch areas.

- Layout and Space Requirements

  Minimum of five picnic tables per area
  Minimum area of 225 square feet per picnic site
  Maximum of 12 tables per acre.

- Facilities

  Concrete tables affixed to concrete impact areas
  One cooking grill or campfire circle per table
  Individual shelters for tables in areas without tree cover
  One trash receptacle per two tables
  Per picnic unit, 1.5 automobile parking spaces.

F.3.24. Boat-Launching Facilities. Boat-launching facilities have been planned to provide access to the river, lakes, bayous, and other water bodies. Each launching ramp will contain a minimum of two launch lanes and would be designed to allow for future expansion.

- Location

  Short and easy access from site entry points and circulation roadways
  Consider localized current and sedimentation pattern
  Provide sufficient deep water area
  Site would offer protection from winds and waves.

- Boat Launching Lanes/Ramps

  Launching lane widths would be 12 feet, total ramp width would be in multiples of this width
  Upper limit of ramp would be 3 feet above the water stage that is equalled or exceeded two percent of time (2 percent flowline)
  Lower limit of ramp would be located 4 feet below the annual average low water elevation
  Minimum of 75-foot diameter vehicular turnaround
  Ramps would be surfaced in scored or patterned concrete that is reinforced or prestressed
  Ramp gradients would be between 13 and 15 percent
  Ramp shoulders would be stabilized to prevent erosion
  Six-inch curbs would be provided on both sides of the ramp
  Mercury vapor lighting on wooden poles would be located adjacent to boat ramps where feasible.

- Courtesy/Loading Dock

  One courtesy/loading dock would be constructed adjacent to the upstream side of each ramp
  Dock would be constructed of concrete with rough surface finish and slope at same gradient as the ramp.

- Parking

  Provide 25 car/trailer spaces per two launching lanes and 50 trailer spaces per five launching lanes.

F.3.25. Hiking Trails. Hiking and interpretive trails would be provided in conjunction with specific public use areas. All trails would be designed to take advantage of the recreational, esthetic, and interpretive potentials of the areas through which they pass. Trails would be designed to follow the contour of the topography in a natural manner. Short day-use trails would be 1 to 3 miles in length; long day-use loops would be 3 to 5 miles in length. Interpretive trails would normally be short, usually less than one mile.

- Clearing

  Tread width 3 feet minimum
  Clearing width 7 feet minimum
  Clearing height 7 feet minimum.

- Gradients

  Less than 10 percent.

- Surface

  Earth for low-usage areas, such as primitive camping.

- Signs

  Minimize number of signs
  Signs at trail heads with health and safety information, as well as length, route, and features
  Mileage markers
  Interpretive markers only where meaningful.

F.3.26. Washhouses. This is discussed as follows:

- Location

  In camping areas, one per 50 campsites.

- Size

  Approximately 810 square feet.

- Facilities

  Three toilets, three showers, and four lavatories for women; two toilets, one urinal, three showers, and four lavatories for men
  Water heater
  Water fountain on exterior wall near entrance
  Water spigot on exterior wall
  Half of washhouses in each campground will contain electrical heating system
  Five parking spaces
  Double laundry tub on exterior.

F.3.27. Picnic Shelter. This is discussed as follows:

- Location

  In major picnic areas at approximately one per 25 picnic sites.

* Size

  Approximately 580 square feet.

* Facilities

  Four charcoal braziers (adjacent), 4 picnic tables, and 2 refuse containers.

F.3.28. Control Station. This is discussed as follows:

* Location

  At selected access points to camping areas.

* Size

  Approximately 216 square feet.

* Facilities

  Space for vehicle backup, two vehicular lanes desirable
  Electric and telephone service
  One lavatory and one toilet.

F.3.29. Playgrounds. Playgrounds would be planned for each developed campground. For safety purposes, these would be located near adult activity areas. Generally, prefabricated play apparatus would be utilized. Innovative and naturalistic timber forms and materials are desirable.

* Location

  Open to partially open area
  In sight of camping or picnic areas
  Adjacent to play field
  Removed from general traffic patterns.

* Layout and Space Requirements

  Two to 3 acres.

* Facilities

  Play apparatus
  Benches for adults.

* Details

  Slides would be permanently installed
  Sand or bark surface.

- Gradient

  Location in relatively flat areas is desirable.

F.3.30. Playfields and Gamecourts. These multi-use facilities would be located adjacent to camping areas. A north-south orientation is desirable for all playfields and gamecourts.

F.3.31. Canoe Trails. Canoe trails would be provided along specific scenic navigable waters. Lengths of trails would vary; however, overnight use would be accommodated by primitive camping areas.

- Canoe Trail Signs

  Signs at trail heads with health and safety information, as well as length, route, and features
  Mileage markers
  Interpretive markers only where meaningful.

F.3.32. Structures (Comfort Station, Washhouses, Picnic Shelters). Structural treatment would emphasize use of native materials and an architectural style that would be compatible with the natural aspects of the region.

F.3.33. Comfort Station. This is discussed as follows:

- Size

  Approximately 450 square feet.

- Facilities

  To be of vandal-resistant and fire-resistant design
  Three toilets and 3 lavatories for women; 2 urinals, 1 toilet, and 2 lavatories for men
  Water fountain on exterior wall near entrance
  Water spigot on exterior wall
  Five parking spaces.

F.3.34. Playfields. This is discussed as follows:

- Layout

  Open or partially open fields, 2 to 3 acres in size where practical, cleared and seeded.

- Facilities

  Provide softball field outline and backstop 16 feet tall constructed of chain link, painted green.

F.3.35. Gamecourts. These are discussed as follows:

- Layout

  Open area of 8,000 square feet minimum.

- Facilities

  Provide appropriate number of courts with line delineating game spaces. Court would be surfaced with concrete and, where not subject to flooding have a 10-foot high chain link fence, painted green, around all sides.

- Gradient

  One inch in 10-foot optimum slope in direction of existing grade.

F.3.36. Fishing Piers. Fishing piers would be provided where feasible at developed campgrounds to accommodate use by campers. These would be designed to allow access for the handicapped.

- Location

  Short and easy access from campground or circulation roadways
  Extend over body of water having fishing potential.

- Size

  Approximately 20 feet long and 10 feet wide.

- Details

  Solid construction with pilings
  Guard rails
  Five parking spaces.

F.3.37. Roads. Park design speeds would generally be less than 30 mph. Rights-of-way clearing, cutting and filling, and use of roadway structures would be minimized. Circulation roadway design should be based on the standards delineated in EM 1110-2-400.

F.3.38. Parking Areas. Parking lot planning and design would minimize the visual impact of the automobile, serve the recreational activity from an appropriate distance, and preserve existing vegetation for shade and screening, and provide esthetic artificial or natural barriers along lot limits. Parking lots would be screened from roadways and all recreational activity areas. Situations, such as cars backing from parking spaces directly into circulation routes would be avoided. Swales and interceptor ditches would be utilized to control storm drainage.

* Layout and Space Requirements

  Car parking spaces 10 by 20 feet with 20-foot aisles
  Car-trailer parking spaces - 10 by 35 feet at 45-degree angle with 25-foot aisles
  Include area for overflow parking.

* Surface

  Bituminous paving or crushed stone as appropriate.

F.3.39. Wastewater Disposal. Wastewater, principally sewage, generated at recreation sites, would be treated and disposed of primarily through the use of septic tank systems, if the topography and soil conditions at the sites are conducive to soil matrix absorption and stabilization of sewage flows. Septic tank systems would include installation of concrete tank, distribution piping, and filter field. If septic tank systems are not feasible, package treatment units would be installed. Sites where package waste water treatment units are required would employ extended aeration package units on concrete pads with effluent piping, and discharge to the appropriate water body.

F.3.40. Wastewaters from drinking fountains would simply be allowed to run off untreated, following the natural drainage gradients surrounding their supporting structures as practiced at Louisiana State Park facilities. A gravel sump to handle water and prevent muddy conditions would be provided.

F.3.41. Refuse Disposal. Refuse generated at recreation sites would be collected in trash receptacles provided where appropriate, according to the US Army Corps of Engineers Standards for Recreation Facilities. Commercial refuse disposal contractors would be engaged to collect and dispose of the contents of receptacles. A pack-it-in, pack-it-out policy would be established at primitive sites and trails.

F.3.42. Site Work: Grading and Landscaping. The approach to all site work would be to minimize impact on the existing conditions.

* Clearing and Grubbing

  Specimen trees would be retained when possible; cleared areas would be contoured and seeded to prevent erosion.

* Grading

  The extent and impact of grading operations would be minimized. Natural appearance and smooth transition to existing grade is desirable.

- Seeding and Sodding

  Large areas disturbed by construction would be seeded and mulched. Areas would be sodded near buildings or major activities, where it is imperative to establish grass quickly.

- Landscaping

  Landscape planting would be simple, functional, and economical to maintain; generally, plantings would reflect the natural vegetative associations of the site environs.

F.3.43. Signs. The use of signs would be minimized. Signs would be informative and unobtrusive, and the use of graphic symbols is preferred. Signs at areas operated and maintained by the US Army Corps of Engineers should conform to standards of Lower Mississippi Valley Division sign manual DIVR 1130-2-130.

F.3.44. Barrier Free Access. Sites walkways and steps/ramps would be planned to allow access for the handicapped, as provided for in the Architectural Act of 1968 (Public Law 90-490). Handrails would be provided at walks and steps where appropriate. Buildings, and where possible recreation facilities, would include facilities usable by the physically handicapped.

F.3.45. Visitor Safety Control. Control points would be provided at all access points to major recreation developments. Visitor circulation to particular areas of a site could also be controlled.

F.3.46. Visitor Assistance and Protection. Common recurrent hazards and unsafe conditions would be identified and procedures implemented to protect the public and take measures that would minimize the likelihood of personal injury.

- Control Stations

  The function of a control station is to regulate use by collecting fees and issuing use permits, as well as to provide security, first aid, information, and directions.

- Road Gates

  To prevent vehicular traffic into potential danger areas, management areas, or sites closed for operational purposes.

- Protective Fencing

  Fencing, of appropriate type and visual character, would be utilized to prevent access to certain areas or sites where dangerous situations exist.

F.3.47. Flood-Proofing. Recreational facilities would be located above the 10-year flood plain where practicable. If subject to flooding, the facilities would be designed to stay in place during flood conditions and to facilitate clean-up and restoration to service afterwards.

F.3.48. Recreational structures that are subject to damage by flooding would be located above the 100-year flood plain where practicable. Elevations may be raised by filling or by structural means. At locations where this is not practicable, the structures and facilities would be constructed of materials that would not be severely damaged by flooding. Structures subject to flooding should be designed to accommodate hosing out of silt and sediment after flooding.

F.3.49. A system for disconnection of electrical service and other utilities that could be damaged or create a hazard would be located above the flood plain.

DETAILED DEVELOPMENT PLAN

F.3.50. The outstanding recreational attraction of the Atchafalaya Basin is implicit in its relatively undeveloped natural environment. While low-lying swamps and periodic inundations have hindered large land-use changes and curtailed development, they have also provided a degree of protection to the basin and have helped to preserve its natural character. This plan recognizes these inherent natural qualities; and while not attempting to disrupt them, does attempt to make the basin more accessible to the public. The concept of use is to provide large areas of undeveloped lands as the base of public use and develop necessary facilities to support that use at strategic locations.

F.3.51. The primary recreation attraction would be based on those lands secured for public access. Most of these lands would remain in a natural state, having little or no development. Hunting would likely be the main land-based activity; while, fishing would be the major water-based activity. Nonconsumptive recreational uses would be specifically provided for in the development of a portion of the publicly accessible land.

F.3.52. The most intensively developed areas would provide three campground parks (Figure F-3-1). Plate F-1 shows the approximate locations of campground sites A, B, and C. Sites A and B were chosen because of their proximate locations to I-10, the major transportation route which crosses the basin floodway, and because of their direct accessibility to the Baton Rouge and Lafayette metropolitan areas. Both sites would serve the northern protion of the basin, with Site A

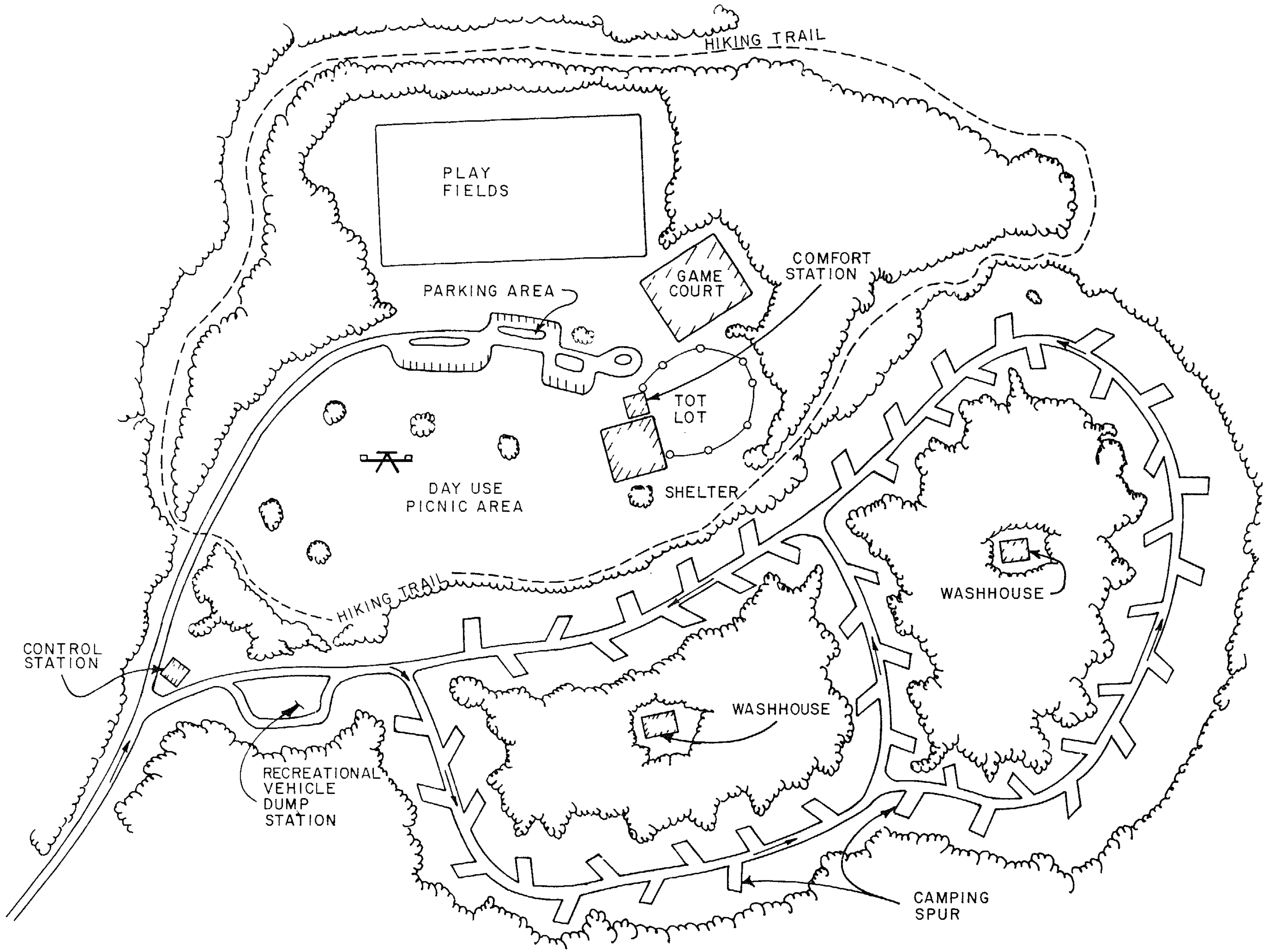

FIGURE F-3-1 CONCEPTUAL SITE DEVELOPMENT PLAN serving areas west of the Atchafalaya River and Site B serving areas east of the Atchafalaya River. Two sites are proposed, because the only road link between the two park sites is I-10, which bridges the river that forms a natural barrier to cross-basin use. Site C, which lies along State Highway 70 about 16 miles north of Morgan City and US Highway 90, was selected to provide camping to users of the southern half of the basin. No campground development is recommended on the western side of the lower half of the basin floodway because of Lake Fausse Point State Park, which is currently being constructed in that general area. Camping facilities are part of its developmental scheme.

F.3.53. Sites A and C would encompass 200 acres each, while Site B would total 300 acres. Each site would consist of a 100-acre park development and an additional 100 acres for future expansion. In addition, Site B would contain a 100-acre area for the development of a combination nature and hiking trail. All three sites are located on lands of higher elevation that are flooded less frequently.

F.3.54. Each park would be developed for both overnight and day-use and would contain 100 campsites that are fully developed for use by camping trailers and recreational vehicles. Some sites would be constructed and specifically designated for use by the handicapped. Included amenities are concrete tables and impact pads, electrical hook-ups, water, charcoal grills, and trash receptacles at each campsite. Actual park design may include areas for tent camping only; however, for this study effort no such specific allowance has been made.

F.3.55. Each campground would also provide washhouses with hot showers, a recreational vehicle dump station, and a park attendant control station. A tot-lot type playground, game field, and game court for each park would also be provided as support facilities for campers. A separate day-use area consisting of 25 picnic tables with grills, a picnic shelter, a courtesy fishing pier (if feasible) and a comfort station would be provided for day-use visitors at each of the three parks.

F.3.56. It is anticipated that water would be supplied by a drilled well and pressure system, and sewage would be disposed of by septic systems. Park access roads and interior circulation roads would be hard-surfaced.

F.3.57. The park at Site B would also include a 5-mile-long raised boardwalk nature-interpretive trail that wanders over and through an adjacent swampland ecosystem.

F.3.58. Although the three developed parks would act as support facilities for visitors who wish to pursue interests on the many acres of undeveloped public access lands located throughout the basin, these campgrounds would be completely developed and self-sustaining, offering a wide spectrum of onsite recreational uses.

F.3.59. The initial 100-acre development is appropriate for that scale of use envisioned for the immediate future, based upon today's needs.

F.3.60. The 100 acres set aside for future expansion at each of the developed campgrounds are necessary to provide for long-range future recreational needs, which are difficult to assess by today's standards but which will most likely occur as the use and popularity of the floodway and its natural and recreational attributes become more widely recognized. The detailed development of these acres is incumbent upon future planning efforts.

F.3.61. While the developed campsites serve overnight and day-use in proximity to the highways, seven primitive campsites would be developed to accommodate users within the interior of the floodway where road access is limited or nonexistent. These primitive camping areas would be located along scenic interior corridors and would be accessed by boat and/or canoe.

F.3.62. In most instances these areas are linked by waterways that form a continuous north-south canoe trail that runs the length of the basin floodway. Depending upon the specific location and water elevation, some of the primitive campgrounds may be accessible to hikers. The approximate locations of the seven primitive camping areas are shown on Plate F-1. Where feasible, intervals between the sites were placed at distances that would accommodate a day's travel by canoe. Each of the seven primitive camping areas would be 50 acres in size and have 25 campsites per area. Each campsite would consist of a brush-cleared area and a fire ring. Trash would be carried out by the individual and be deposited at the trail head boat launch area. Each campground would be provided with a vault-type or portable comfort station, where feasible and necessary. Water on each site would be supplied by hand-pump wells where feasible.

F.3.63. A mile-long hiking trail would also be provided at each campground. These trails would be developed along the campground's fee perimeter and would require no additional acquisition for public access. Trailheads would be established for the primitive camping areas. Primitive campers would utilize designated existing and proposed launch areas as a point of embarkation, as well as a point of exit. These designated boat-launching areas would be upgraded or developed to accommodate additional parking for recreationists wishing to use the primitive campgrounds. A primitive campground, while minimal in terms of development, would be a major asset in the overall recreation plan. It would provide the means for overnight use of the interior of the basin while increasing the diversity of use, and yet maintaining a minimal development concept.

F.3.64. The major means of accessing the interior of the Atchafalaya Basin Floodway is by boat. Adequate boat-launching areas are very important in providing for overall public recreational use. A recreational facilities inventory of the basin has identified 44 existing boat-launching sites that are currently being used for interior access. While some are private commercial launch sites, many are public. An inventory of public ramps revealed that many are in poor condition and are not being maintained.

F.3.65. Based on an analysis of existing use conditions and pressures, this plan recommends the upgrading of 10 existing launch ramps. Five of the ramps would be upgraded to five lanes each, and five ramps would be upgraded to two lanes each. Parking at each would be expanded. In addition, five new ramps (two 5-lane ramps and three 2-lane ramps) are proposed for development. Plate F-1 identifies the approximate location of each ramp to be upgraded or constructed.

F.3.66. Each proposed launch area would encompass 10 acres and provide permanent concrete ramps and paved parking: 50 car and trailer spaces for 5-lane ramps, or 25 car and trailer spaces for 2-lane ramps. Each ramp would have one courtesy dock and where feasible, lighting. In addition, a comfort station, five picnic tables, five barbeque grills, and five trash receptacles would be provided at each launch area. In many areas, public access across the levees is prohibited. The launch areas would provide for public access across levees in these instances. As such, their importance extends beyond that of boat-launching areas in providing a means of public access for crawfishing, bankfishing, and other recreational activities. In addition, many of the launch areas would serve as the staging areas for primitive campers. Launch areas would play an important dual role in facilitating public recreational use of the basin.

F.3.67. The US Army Corps of Engineers, would construct and operate a Project Visitor's Center, located on 100 acres near the Bayou Sorrel Indian Mound Site on the east side of the lower Atchafalaya Basin Floodway.

F.3.68. The Project Visitor's Center is required to serve a number of functions to accomplish its purpose of communicating the reason for the Atchafalaya Basin Floodway and related project features. To merely echo past and present project planning, construction, and operation processes would not provide the visitor with adequate information to comprehend the rationale and history of a project dating back some 50 years and continuing into the future. To accomplish these objectives, the Project Visitor's Center would:

- Involve the visitor emotionally and physically with the site, and thus, in the floodway project

- Provide the visitor with the information necessary to explore the full range of recreational opportunities made available by the floodway

- Provide an interpretation of the natural resources intrinsic to the Atchafalaya River Basin and the floodway

- Provide and interpretation of the cultural resources related to the Atchafalaya Basin, focusing on the continuing interaction of man with the floodway

- Interpret the role of the US Army Corps of Engineers in the development of the floodway

- Provide information that would enable the visitor to make a conceptual linkage between the Visitor's Center site and other significant sites associated with the project

- Be a visual symbol of the project's emphasis, quality, and purpose.

F.3.69. Achieving these objectives would instill the visitor with an emotional as well as physical consciousness of the floodway's purpose, creation, and benefits.

F.3.70. There are several reasons for selecting the Bayou Sorrel Indian Mound site as the location for the multi-use project Visitor's Center. The mound itself is a highly significant cultural resource because it has been identified as one of the key sites in the Atchafalaya Basin that has the potential of revealing historical succession, and affords opportunity to study human adaptation to a changing environmental setting. The site is conducive to interpretive presentation and is publicly accessible from I-10 and from the Plaquemine, Baton Rouge, and Morgan City areas. In addition, this site location would not conflict with that of the planned Atchafalaya Wilderness Center, which will be constructed by the Louisiana State Parks Department near Catahoula on the west side of the floodway.

F.3.71. The Visitor's Center would include a museum and audio-visual interpretive elements housed in an attractive rustic contemporary structure. The theme of the exhibits would interpret the role of the US Army Corps of Engineers in the development of the project, as well as natural and cultural resources of the region.

F.3.72. Ancillary facilities would be developed on the Visitor's Center site. A 25-unit picnic area would be constructed close to the center, as well as an amphitheater designed to seat 100 persons. These facilities would support heavier use during the summer. The amphitheater would be built close to the trailhead of a 1.5-mile nature trail and would serve as a gathering point for visitors awaiting guided nature walks. The amphitheater would be used for outdoor interpretive programs during warm-weather months.

F.3.73. The facility development as described in this section is summarized by type and number in Table F-3-1.

F.3.74. Two existing facilities have been identified as having the potential to be upgraded into visitor information centers capable of disseminating current and useful information about the Atchafalaya Basin Floodway and directing potential visitors to its attractions. The I-10 Rest Stop at the Butte LaRose Interchange and Brownell's Memorial Park and Carillon Tower just northeast of Morgan City are ideally located to provide services to the majority of cross-basin travelers, and as visitor information centers, would greatly aid in optimizing public access and use of the Atchafalaya Basin Floodway and its resources.

TABLE F-3-1

ATCHAFALAYA BASIN STUDY
RECOMMENDED PLAN OF RECREATIONAL DEVELOPMENT
FACILITY DEVELOPMENT SUMMARY

Facility Development	Campgrounds	Primitive Campgrounds	Visitor Center	Boat-Launching Areas	Elevated Nature-Hiking Trail	Totals
Number of Development Sites	3	7	1	15	1	27 sites
Acres	600	350	100	150	100	1,300 acres 1/
Developed Camping Units	300					300 units
Tent Camping Pads	300					300 pads
Day-Use Picnic Units	75		25	75		175 units
Playgrounds	3					3 playgrounds
Playfields	3					3 playfields
Multi-Use Courts	3					3 multi-use courts
Nature Trail						0
Fishing Pier	3					3 fishing piers
Hiking Trail Miles		7	1.5			8.5 miles hiking trail
Five Lane Boat-Launching Areas				7		35 lanes
Two Lane Boat-Launching Areas				8		16 lanes
Amphitheater			1			1 amphitheater
Picnic Shelter	3					3 picnic shelters
Comfort Station (Waterborne)	3		1			4 comfort stations
Comfort Station (Vault)		7		15		22 comfort stations
Control Station	3					3 control stations
Washhouse	6					6 washhouses
Graded Primitive Camping Site (Including Fire Ring)		175				175 units

1/ 200 acres designated for special or unique features are not included in 1,300 acre total.

Section 4 - ANNUAL VISITATION CALCULATIONS

F.4.1. Annual recreation attendance has been calculated by the Capacity Method of Determining Use, as presented in Section 713.917b.(4) contained in ER 1105-2-300, 15 July 1980. In using this method, recreational use is held constant over time; therefore, future use projections will not differ from initial use projects resulting from the implementation of the recommended recreation plan.

F.4.2. To determine annual use, the optimum use standards presented in Table F-2-2 were multiplied by the number of facilities recommended for development to determine the daily facility design capacities. The design capacities were then multiplied by 91.5 high quarter days to measure optimal use in that period of the year where it would most likely approach the facility design capacity. By determining high quarter use, annual attendance could be calculated by expanding high quarter use over the remaining three quarters of the year.

F.4.3. From the Outdoor Recreation Resources Review Commission (ORRRC) Study Report No. 19, page 363, the percentage by summer high quarters of recreation outings which occurred was analyzed to yield a conversion factor of 50.7 percent for active recreational pursuits, excluding activities, such as sightseeing, for which no unit standard has been developed. By applying this 50.7 percent conversion factor, the high quarter use can be annualized.

F.4.4. To convert to user days of annual attendance, annual respective activity occasions excluding those for boat fishing and the different hunting activities were divided by 1.28, the national average number of activity occasions per user day for all US Army Corps of Engineers Water Resource Development Projects. For this study, boat fishing and the different hunting activities are equated on a one-to-one basis per use day in the project area. This is based upon observed duration of use as reflected in the 1971-1974 "Atchafalaya Basin Usage Study." Table F-4-1 shows the incremental calculations and the computed total annual use that would occur in the Atchafalaya Basin Floodway upon implementation of the recommended recreation plan.

F.4.5. There are several modifications to the calculations that should be noted:

- Multi-use fields normally have a turnover rate of 2. Because of the remoteness of developed camping and the lesser amount of anticipated day-use, the "turnover rate" is expected to be less than 2, hence 1.

TABLE F-4-1

ANNUAL VISITATION CALCULATIONS

	Number of Facilities	Users Per Facility	Turnover Rate Per Day	Facility Design Capabilities in Activity Occasions	High Quarter Factor 91.5 Days	Activity Annualization Factor 0.507	Activity Occasion Conversion Factor	Total Annual Visitation
General Recreation								
1. Primitive Camping	175 units	4	1	700	64,050	126,331		
2. Developed Camping	300 units	4	1	1,200	109,800	216,568		
3. Hiking	12 miles	5	4	240	21,960	43,314		
4. Nature Trail	1 trail	10	4	40	3,660	7,219		
5. Nature Photography/ Birdwatching	2 miles	10	4	80	7,320	14,438		
6. Picnicking	175 units	3.85	2	1,348	123,296	243,188		
7. Picnic Group Shelter	3 shelters	7.5	2	45	4,118	8,122		
8. Multi-use Field	3 fields	20	1	60	5,490	10,828		
9. Multi-use Court	3 courts	10	1	30	2,745	5,414		
10. Playground	3 playgrounds	31	1	93	8,510	16,785		
11. Amphitheater	1 amphitheater	100	1	100	9,150	18,047		
12. Power Boating	15 lanes	4	16	960	87,840	173,254		
13. Nonpower Boating	3 lanes	2.25	16	108	9,882	19,491		
					Subtotal	902,999	1.28	705,468
Fishing								
14. Fishing, Boat	35 lanes	2.5	20	1,750	160,125	315,828		315,828
15. Fishing, Pier	3 piers	5	2	30	2,745	5,414		
16. Fishing, Bank	9.5 miles	48	3	1,368	125,172	246,888		
17. Crawfishing	6 miles	20	1	120	10,980	10,980		
18. Crabbing	6 miles	66	1	396	36,234	36,234		
					Subtotal	299,516	1.28	233,997
						GRAND TOTAL		1,255,293

• The nature trail at developed campsite B is 5 miles in length, thereby giving it use characteristics that more nearly approach those of a hiking trail--the activity type that it was measured under.

• Power boating and nonpower boating were noted as having 15-lane and 3-lane equivalents of supply, respectively. This is based upon the amount of time in a day that a lane could be utilized by one of these activities. Thirty-five lanes that accommodate boat fishing also accommodate 4 hours or 1/2-day of use per lane per day of power and/or nonpower boating. The method for determining the amount of lane equivalent use by these activities is:

• 35 lanes x 4 hours use for power and nonpower = 140 hours use per day of availability

• 140 hours per day ÷ 8 hours in a day = 17.5 lanes of availability per day

• According to the needs analysis for year 2030:

Power boat needs	=	303 lanes
Nonpower boat needs	=	42 lanes
TOTAL		345 lanes needed

• 303 ÷ 345 = 0.88 or 88 percent of the toal is power boat need

• 42 ÷ 345 = 0.12 or 12 percent of the total is nonpower boat need

• 17.5-lane equivalents supplied x 0.88 = 15-lane equivalents allocated to power boating

o 17.5-lane equivalents supplied x 0.12 = 3-lane equivalents allocated to nonpower boating.

F.4.6. While many areas will be available for bankfishing, crawfishing, and crabbing, projected annual visitation is calculated for designated areas where road access is to be provided. These designated areas are generally found at proposed and/or existing launch sites, and are expected to receive the most concentrated use. Areas excluded from this measurement should not be considered as having no recreational use potential. Some areas, including a large portion of the publicly accessible acres of cypress-tupelo, offer great crawfishing potential; however, access is limited only to boats, thereby reducing the intensity of use which is in itself difficult to measure.

F.4.7. Crabbing and crawfishing were converted from users per linear foot to users per linear mile. Calculated attendance for these activities is computed as follows:

- Crawfishing:

  5,280 feet ÷ 266 feet/user = 20 users/mile
  20 users/mile x 6 miles = 120 users or the daily facility design capacity
  120 users/mile x 91.5 high quarter days = 10,980 users/high quarter.

- Crabbing:

  5,280 feet ÷ 80 feet/user = users/mile
  66 users/mile x 6 miles = 396 users or the daily facility design capacity
  396 users/mile x 91.5 high quarter days = 36,234 users/high quarter.

F.4.8. Crabbing and crawfishing both occur on a strictly seasonal basis. Expansion to an annual figure by use of the 0.507 conversion factor for these activities would be erroneous. Thus, for visitation calculations, respective high quarter uses for these activities are to be considered as respective total annual visitation for each.

F.4.9. Birdwatching and nature photography will be provided at the 200-acre special and unique site. For attendance calculations, that area is expected to receive use that approximates that of a developed nature trail.

Section 5 - PLAN ALTERNATIVE ASSESSMENT

F.5.1. General. Fishing and hunting are the most significant recreational activities that occur in the Atchafalaya Basin. This is substantiated by data contained in past user studies, by present day observations of existing recreational use trends, and by future needs, as exhibited in comprehensive recreation demand-need analyses of the basin's market area and zone of influence. The following analyses address the impacts of each plan alternative under consideration as part of the Atchafalaya Basin Land and Water Use Study on the land and water resources that will support these activities.

RECREATIONAL WATER USE ANALYSIS

F.5.2. In the Atchafalaya Basin recreation demand-need analysis, water-based recreational activities were analyzed from the standpoint of access. As stated in the Louisiana State Comprehensive Outdoor Recreation Plan (SCORP), Louisiana has an abundance of both fresh and saltwater areas with recreation potential. However, many of these areas are unavailable to the public because of a lack of boat access sites. Boat access to suitable water is a major consideration of water-based activities. Therefore, the supply, demand, and needs calculations concerning these activities were based on boat access or boat-launching ramps. To properly evaluate the future carrying capacities of the floodway in terms of the overall development of boat launching facilities (existing and proposed) and the amount of surface water acreage needed to support their launching capabilities under all plan alternatives, the following analysis was performed.

F.5.3. Primary consideration is given to freshwater boat fishing, which is the most frequently pursued water-based recreational activity occurring in the floodway. Power boating and nonpower boating are second and third, respectively, in their frequency of use. Water-skiing in the basin is minimal. Existing development will provide adequately for that activity. The facility use standards as stated in the demand-need analysis section of Appendix F and the water acreage use standard as derived from the Louisiana SCORP are presented for the above boating activity types to calculate acres of need per lane per day.

- Boat fishing

  Acreage needed for one boat/day = 8
  Water turnover/day = 3
  Boat launch lane turnover/day = 20
  20 x 1/3 x 8 = 53.28 acres need/lane/day

- Power Boating

  Acreage needed for one boat/day = 20
  Water turnover/day = 3
  Boat launch lane turnover/day = 16
  20 x 1/3 x 16 = 107 acres need/lane/day.

- Nonpower Boating

  Acreage needed for one boat/day = 24
  Water turnover/day = 3
  Boat launch lane turnover/day = 16
  24 x 1/3 x 16 = 128 acres need/lane/day.

F.5.4. Lane-use allocation is based primarily upon the ranking of importance for the respective water-based recreational activity in terms of both actual use and market area need.

F.5.5. The importance and priority ranking of the three boating activities have been previously stated, and the 2030 market area need for these activities reflects that ranking.

Boat Fishing	474 lanes
Power Boating	303 lanes
Nonpower Boating	42 lanes

F.5.6. Including the 35 lanes proposed for construction, a project total of 132 lanes will access the floodway's interior in the year 2030. Based on the above stated priorities and information contained in the discussion of facility use standards and modifications, the 132 boat launching lanes will accommodate 10 hours or a full day of boat fishing and 4 hours or one-half a day to be divided between power and nonpower boating. Use allocated to power and nonpower boating will be prorated on a percentage of need basis.

	2030 Need	Percent of Total
Power Boating	303 lanes	87
Nonpower Boating	42 lanes	13
TOTAL	345 lanes	100

F.5.7. A full day of boat fishing constitutes use of 132 lanes; a 1/2 day of power and nonpower boating combined constitutes an equivalent use of 66 lanes (132 lanes x 1/2-day = 66 equivalent lanes of availability per day). When divided on the prorated percentage basis, 57 of the 132 lanes will be allocated to power boating and nine of the 132 lanes will be allocated to nonpower boating.

F.5.8. Total water surface acres needed per day to accommodate the optimal use generated by the 132 lanes can be calculated by multiplying lane allocations for each activity type by the number of acres needed per lane per day and summing the acreage need of each.

Activity	Lane Allocation	Water Surface Acres of Need/Lane/Day	Water Surface Acres of Need/Lane/Day
Boat Fishing	132	53.28	7,033
Power Boating	57	107	6,099
Nonpower Boating	9	128	1,152
Total Need of Water Surface Acres			14,284

F.5.9. The total water surface acreage of need for the Atchafalaya Basin Floodway for the year 2030 based upon boat access for water-based recreational use is 14,284 acres. This acreage of need will remain constant over the rest of the project life in the absence of additional boat-launching facility construction.

F.5.10. In considering the impacts of each plan alternative on water-based recreational activities requiring boat access to the Atchafalaya Basin Floodway, the total number of water surface acres of available supply to support boating activities versus acres needed were comparatively analyzed, with the following conclusions.

F.5.11. Most all water-related recreational activities requiring boat access will occur on three distinct aquatic habitat types: bayous, headwater lakes, and backwater lakes. The total combined supply acreage figures of these habitat types for the year 2030 for the three different plans under consideration range from a minimum of 27,776 water surface acres for Plan 7 (NED) to a maximum of 34,029 water surface acres for Plan 4 (EQ). Data are not available to forecast conditions beyond 2030, but if trends under any plan continue throughout the project life, future water surface acres would continue to decrease but still be able to sustain projected future use.

F.5.12. Both Plan 4 (EQ) and Plan 9 (R) include real estate features that will increase public access and recreational use of the floodway. If implemented, either plan would, as a result of recreational development, produce a gross water surface acreage need of 14,284 acres for the year 2030 for water-based recreational activities requiring boat access to the floodway. As these plan alternatives have the most extensive recreational development features when compared to others under consideration, they reflect maximum gross need figures for all plan alternatives.

F.5.13. Because the maximum gross need figure of 14,284 water surface acres for all plan alternatives is well below the minimum amount of available supply acres for each plan alternative, there are no tangible net impacts between the future without-project and the different plan alternatives on the basis of water-oriented recreation. Losses will, however, decrease the quality of the outdoor experience as preferred aquatic habitat types, such as headwater and backwater lakes, decrease in total acreage causing a shift in future use concentrations to the less preferred bayous and canals.

RECREATIONAL LAND USE ANALYSIS

F.5.14. Each plan alternative as analyzed in this study effort will have a generally predictable effect on the terrestrial habitat types located within the project area. Shifts in the types and amounts of each habitat will impact the physical and biological resource potentials that attract and support recreational use.

F.5.15. The assessment of impacts on recreation is complicated because the three plan alternatives under consideration have existing recreational usage that will be affected by the above mentioned land changes, while two of the three plans have proposed additional recreational development features that will incur recreational usage over and above that usage common to all plans.

F.5.16. To assess the impacts of the three plan alternatives on recreation, each plans impacts on existing and future recreation usage was evaluated by comparing existing use trends with the availability of different land-use types and projecting these amounts into the future, with the impacts of the proposed features being added on for those plan alternatives that incorporate recreational development.

F.5.17. The exact amount of existing recreation use occurring in the Atchafalaya Basin is not known, although the major activity types, as well as general use patterns, have been identified. Quantification has not been possible because of a lack of data and difficulty in estimating use of private land for recreation; however, it is known that hunting is the primary land-based activity pursued in the basin, and it occurs predominantly on private land. Measuring the effects of land changes on hunting for each alternative will be a prime determinant in assessing the impacts of that plan for several reasons. Hunting has dominated as an activity that has been less susceptible to population changes and user preferences. Hunting relies heavily on the existing land types to support the current use levels, and any change in land types and amounts resulting from a plan implementation will alter that activity level. The capacity of the land to support a given number of man-days per acre of hunting supply based upon habitat carrying capacity (biological sustained harvest rate) can be measured according to gains or losses of habitat acreage, and thereby serves as a means to effectively evaluate the impacts of the different plan alternatives on recreation.

F.5.18. The recommended recreational development features impose identical impacts on those plan alternatives in which they are incorporated. The recreation plan provides for public facility development, as well as for stewardship of prime, publicly accessible, yet undeveloped lands.

F.5.19. The actual development of lands will occur on 1,500 acres, and while eliminating the existing hunting use, will provide more diverse and intense recreational uses. Hunting lands will be replaced by camping areas, picnic areas, and boat-launching areas. The net contribution in user-days of recreation supply of the developed recreation plan will be the number of days that the plan provides less the number of days of existing use displaced by the development.

F.5.20. The undeveloped land to which access is acquired will, under a management and enhancement program, yield a higher and better use in terms of a net increase and supply of man-days of recreational hunting. These additional days of supply will be added to those of the respective plan alternatives and comparatively analyzed.

F.5.21. The results of comparative analysis of each plan alternative are shown in Tables F-5-1 through F-5-6. The tables show total acres available for each hunting activity by habitat type (described in detail in the EIS), carrying capacity (biological harvest rate in man-days per acre for each hunting activity type), man-days of hunting supply, and total gains or losses in 10-year increments from 1986-2036 for the various plan alternative as compared with those of the future without-project conditions. Acreage figures are adjusted to account for shifts in land-use from private to public and from nondeveloped to developed, as based upon the implementation of respective plan alternatives. The year 1986 was used for these calculations because it was established as the first year of economic life for the project. Values calculated for the year 2030 will be held constant throughout the additional 50 years of the project life for economic valuation purposes. Although no detailed data is available for those 50 years of the project life beyond 2030, general impacts based on trend analyses are addressed for that time period. The comparative impact calculations of the recommended plan are not shown in tabular form; however, the results are included in Table F-5-7 and discussed in the narrative in section F.5.32.

DOLLAR VALUATION OF RECREATION USER DAYS

F.5.22. The Water Resources Council in its "Procedures for Evaluation of National Economic Development (NED) Benefits and Costs In Water Resources Planning" (Level C); Final Rule, describes several different methodologies for evaluating recreation benefits. The preferred means to forecast use and derive recreation benefits are through the

TABLE F-5-1

ATCHAFALAYA BASIN STUDY
FLOODWAY AND 1/4-MILE STRIP
IMPACTS OF PLAN ALTERNATIVES

Habitat Type	Big Game Hunting Carrying Capacity	Plan 2 (FWOP) Gross Acres	Plan 2 (FWOP) Adjusted Acres	Plan 2 (FWOP) Net Acres	Plan 2 (FWOP) User Day Supply	Plan 4 (EQ) Gross Acres	Plan 4 (EQ) Adjusted Acres	Plan 4 (EQ) Net Acres	Plan 4 (EQ) User Day Supply	Plan 7 (NED) Gross Acres	Plan 7 (NED) Adjusted Acres	Plan 7 (NED) Net Acres	Plan 7 (NED) User Day Supply	Plan 9 (TS) Gross Acres	Plan 9 (TS) Adjusted Acres	Plan 9 (TS) Net Acres	Plan 9 (TS) User Day Supply	Year
LSBH	0.209	253,000		253,000	52,877	260,000	-14,000	216,000	45,144	253,000		253,000	52,877	260,000	-14,000	216,000	45,144	1986
LSBH	0.539	-		-	0	-		30,000	16,170	-		-	0	260,000		30,000	16,170	
ESBH	0.124	73,800		73,800	9,151	76,300	-1,900	74,400	9,226	73,800		73,800	9,151	76,300	-1,900	74,400	9,226	
CU	0.124	6,400		6,400	794	5,500		5,500	682	6,400		6,400	794	5,500		5,500	682	
BH/CT	0.101	10,400		10,400	1,050	11,700		11,700	1,182	10,400		10,400	1,050	11,700		11,700	1,182	
C-T	0.077	173,000		173,000	13,321	171,000	-8,000	113,000	8,701	173,000		173,000	13,321	171,000	-8,000	113,000	8,701	
C-T	0.113	-		-	0	-		50,000	5,650	-		-	0	-		50,000	5,560	
OL	0	23,500		23,500	0	16,000	-100	15,900	0	23,500		23,500	0	16,000	-100	15,900	0	
FM	0.014	0		0	0	0		0	0			0	0	0		0	0	
SM	0	0		0	0	0		0	0			0	0	0		0	0	
BM	0	0		0	0	0		0	0			0	0	0		0	0	
D	0.014	0		0	0	0		0	0			0	0	0		0	0	
Total					77,193				86,755				77,193				86,755	
LSBH	0.209	225,000		225,000	47,025	266,000	-14,000	222,000	46,398	224,000		224,000	46,816	266,000	-14,000	222,000	46,398	1996
LSBH	0.539	-		-	0	-		30,000	16,170	-		-	0	-		30,000	16,170	
ESBH	0.124	58,200		58,200	7,217	64,100	-1,900	62,200	7,713	63,800		63,800	7,911	64,500	-1,900	62,600	7,762	
CU	0.124	16,800		16,800	2,083	14,400		14,400	1,786	14,600		14,600	1,810	14,400		14,400	1,786	
BH/CT	0.101	12,400		12,400	1,252	17,100		17,100	1,727	22,900		22,900	2,313	17,100		17,100	1,727	
C-T	0.077	166,000		166,000	12,782	162,000	-8,000	104,000	8,008	154,000		154,000	11,858	162,000	-8,000	104,000	8,008	
C-T	0.113	-		-	0	-		50,000	5,650	-		-	0	-		50,000	5,650	
OL	0	61,500		61,500	0	16,800	-100	16,700	0	63,900		63,900	0	17,000	-100	16,900	0	
FM	0.014	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.014	0		0	0	0		0	0	0		0	0	0		0	0	
Total					70,359				87,452				70,708				87,501	
LSBH	0.209	169,000		169,000	35,321	265,000	-14,000	221,000	46,189	166,000		166,000	34,694	265,000	-14,000	221,000	46,189	2006
LSBH	0.539	-		-	0	-		30,000	16,170	-		-	0	-		30,000	16,170	
ESBH	0.124	50,000		50,000	6,200	61,100	-1,900	59,200	7,341	54,900		54,900	6,808	61,500	-1,900	59,600	7,390	
CU	0.124	27,100		27,100	3,360	23,100		23,100	2,864	23,400		23,400	2,902	23,100		23,100	2,864	
BH/CT	0.101	11,400		11,400	1,151	22,600		22,600	2,283	27,600		27,600	2,788	22,600		22,600	2,283	
C-T	0.077	159,000		159,000	12,243	153,000	-8,000	95,000	7,315	140,000		140,000	10,780	153,000	-8,000	95,000	7,315	
C-T	0.113	-		-	0	-		50,000	5,650	-		-	0	-		50,000	5,650	
OL	0	127,000		127,000	0	17,800	-100	17,700	0	133,000		133,000	0	18,100	-100	18,100	0	
FM	0.014	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.014	0		0	0	0		0	0	0		0	0	0		0	0	
Total					58,275				87,812				57,972				87,861	
LSBH	0.209	131,000		131,000	27,379	264,000	-14,000	220,000	45,980	125,000		125,000	26,125	264,000	-14,000	220,000	45,980	2016
LSBH	0.539	-		-	0	-		30,000	16,170	-		-	0	-		30,000	16,170	
ESBH	0.124	41,700		41,700	5,171	58,700	-1,900	56,800	7,043	46,300		46,300	5,741	59,000	-1,900	57,100	7,080	
CU	0.124	37,300		37,300	4,625	31,900		31,900	3,956	32,200		32,200	3,993	31,900		31,900	3,956	
BH/CT	0.101	10,400		10,400	1,050	28,100		28,100	2,838	31,900		31,900	3,222	28,100		28,100	2,838	
C-T	0.077.	153,000		153,000	11,781	146,000	-8,000	88,000	6,776	127,000		127,000	9,779	146,000	-8,000	88,000	6,776	
C-T	0.113	-		-	0	-		50,000	5,650	-		-	0	-		50,000	5,650	
OL	0	174,000		174,000	0	18,400	-100	18,300	0	185,000		185,000	0	18,700	-100	18,600	0	
FM	0.014	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.014	0		0	0	0		0	0	0		0	0	0		0	0	
Total					50,006				88,413				48,860				88,450	
LSBH	0.209	114,000		114,000	23,826	263,000	-14,000	219,000	45,771	107,000		107,000	22,363	264,000	-14,000	220,000	45,980	2026
LSBH	0.539	-		-	0	-		30,000	16,170	-		-	0	-		30,000	16,170	
ESBH	0.124	35,000		35,000	4,340	56,200	-1,900	54,300	6,733	39,700		39,700	4,923	56,600	-1,900	54,700	6,783	
CU	0.124	47,500		47,500	5,890	40,600		40,600	5,034	41,000		41,000	5,084	40,600		40,600	5,034	
BH/CT	0.101	11,100		11,100	1,121	33,500		33,500	3,384	38,200		38,200	3,858	33,500		33,500	3,384	
C-T	0.077	146,000		146,000	11,242	138,000	-8,000	80,000	6,160	114,000		114,000	8,778	138,000	-8,00	80,000	6,160	
C-T	0.113	-		-	0	-		50,000	5,650	-		-	0	-		50,000	5,650	
OL	0	197,000		197,000	0	19,000	-100	18,900	0	212,000		212,000	0	19,200	-100	19,100	0	
FM	0.014	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0	0		0	0	0		0	0	0		0	0	0	0		0	
D	0.014	0		0	0	0		0	0	0		0	0	0		0	0	
Total					46,419				88,902				45,006				89,161	
LSBH	0.209	110,000		110,000	22,990	263,000	-14,000	219,000	45,771	102,000		102,000	21,218	264,000	-14,000	220,000	45,980	2036
LSBH	0.539	-		-	0	-		30,000	16,170	-		-	0	-		30,000	16,170	
ESBH	0.124	32,600		32,600	4,042	55,200	-1,900	53,300	6,609	37,300		37,300	4,625	55,600	-1,900	53,700	6,659	
CU	0.124	51,600		51,600	6,398	44,100		44,100	5,468	44,600		44,600	5,530	44,100		44,100	5,468	
BH/CT	0.101	11,700		11,700	1,182	35,700		35,700	3,606	41,000		41,000	4,141	35,700		35,700	3,606	
C-T	0.077	144,000		144,000	11,088	135,000	-8,000	77,000	5,929	109,000		109,000	8,393	135,000	-8,000	77,000	5,929	
C-T	0.113	-		-	0	-		50,000	5,650	-		-	0	-		50,000	5,650	
OL	0	203,000		203,000	0	19,200	-100	19,100	0	220,000		220,000	0	19,400	-100	19,300	0	
FM	0.014	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.014	0		0	0	0		0	0	0		0	0	0		0	0	
Total					45,700				89,203				44,008				89,462	

TABLE F-5-2

ATCHAFALAYA BASIN STUDY
FLOODWAY AND 1/4-MILE STRIP
IMPACTS OF PLAN ALTERNATIVES

	Small Game		Plan 2 (FWOP)			Plan 4 (EQ)				Plan 7 (NED)				Plan 9 (TS)				
Habitat Type	Hunting Carrying Capacity	Gross Acres	Adjusted Acres	Net Acres	User Day Supply	Gross Acres	Adjusted Acres	Net Acres	User Day Supply	Gross Acres	Adjusted Acres	Net Acres	User Day Supply	Gross Acres	Adjusted Acres	Net Acres	User Day Supply	Year
LSBH	0.168	253,000		253,000	42,504	260,000	-1,000	229,000	28,472	253,000		253,000	42,504	260,000	-1,000	229,000	38,472	1986
LSBH	0.239	-		-	-	-		30,000	7,170	-		-	-	-		30,000	7,170	
ESBH	0.054	73,800		73,800	3,985	76,300	0	76,300	4,120	73,800		73,800	3,985	76,300	0	76,300	4,120	
CU	0.054	6,400		6,400	346	5,500		5,500	297	6,400		6,400	346	5,500		5,500	297	
BH/CT	0.063	10,400		10,400	655	11,700		11,700	737	10,400		10,400	655	11,700		11,700	737	
C-T	0.072	173,000		173,000	12,456	171,000	-300	121,000	8,712	173,000		173,000	12,456	171,000	-300	121,000	8,712	
C-T	0.072	-		-	-	-		50,000	3,600	-		-	-	-		50,000	3,600	
OL	0.042	23,500		23,500	987	16,000	-100	15,900	668	23,500		23,500	987	16,000	-100	15,900	668	
FM	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0.024	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.073	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
Total					60,933				63,776				60,933				63,776	
LSBH	0.168	225,000		225,000	37,000	266,000	-,1000	235,000	39,480	224,000		224,000	37,632	266,000	-1,000	235,000	39,480	1996
LSBH	0.239	-		-	-	-		30,000	7,170	-		-	-	-		30,000	7,170	
ESBH	0.054	58,200		58,200	3,143	64,100	0	64,100	3,461	63,000		63,000	3,402	64,500	0	64,500	3,483	
CU	0.054	16,800		16,800	907	14,400		14,400	778	14,600		14,600	788	14,400		14,400	778	
BH/CT	0.063	12,400		12,400	781	17,100		17,100	1,077	22,900		22,900	1,443	17,100		17,100	1,077	
C-T	0.072	166,000		166,000	11,952	162,000	-300	112,000	8,064	154,000		154,000	11,088	162,000	-300	112,000	8,064	
C-T	0.072	-		-	-	-		-	-	-		-	-	-		-	-	
OL	0.042	61,600		61,600	2,587	16,800	-100	16,700	701	63,900		63,900	2,684	17,000	-100	16,900	710	
FM	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0.024	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.073	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
Total					56,370				64,331				57,037				64,362	
LSBH	0.168	169,000		169,000	28,392	265,000	-1,000	234,000	39,312	166,000		166,000	27,888	265,000	-1,000	234,000	39,312	2006
LSBH	0.239	-		-	-	-		30,000	7,170	-		-	-	-		30,000	7,170	
ESBH	0.054	50,000		50,000	2,700	61,100	0	61,000	3,299	54,900		54,900	2,965	61,500	0	61,500	3,321	
CU	0.054	27,100		27,100	1,463	23,100		23,100	1,247	23,400		23,400	1,264	23,100		23,100	1,247	
BH/CT	0.063	11,400		11,400	718	22,600		22,600	1,424	27,600		27,600	1,739	22,600		22,600	1,424	
C-T	0.072	159,000		159,000	11,448	153,000	-300	103,000	7,416	140,000		140,000	10,080	153,000	-300	103,000	7,416	
C-T	0.072	-		-	-	-		500,000	3,600	-		-	-	-		50,000	3,600	
OL	0.042	127,000		127,000	5,334	17,800	-100	17,700	743	133,000		133,000	5,586	18,100	-100	18,000	756	
FM	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0.024	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.073	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
Total					50,055				64,211				49,522				64,246	
LSBH	0.168	131,000		131,000	22,008	264,000	-1,000	233,000	39,144	125,000		125,000	21,000	264,000	-1,000	233,000	39,144	2016
LSBH	0.239	-		-	-	-		30,000	7,170	-		-	-	-		30,000	7,170	
ESBH	0.054	41,700		41,700	2,252	58,700	0	58,700	3,170	46,300		46,300	2,500	59,000	0	59,000	3,186	
CU	0.054	37,300		37,300	2,014	31,900		31,900	1,723	32,200		32,200	1,739	31,900		31,900	1,723	
BH/CT	0.063	10,400		10,400	655	28,100		28,100	1,770	31,900		31,900	2,010	28,100		28,100	1,770	
C-T	0.072	153,000		153,000	11,016	146,000	-300	96,000	6,912	127,000		127,000	9,144	146,000	-300	96,000	6,912	
C-T	0.072	-		-	-	-		-	-	-		-	-	-		50,000	3,600	
OL	0.042	174,000		174,000	7,308	18,400	-100	-18,300	769	185,000		185,000	7,770	18,700	-100	18,600	781	
FM	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0.024	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.073	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
Total					45,253				64,258				44,163				64,286	
LSBH	0.168	114,000		114,000	19,152	263,000	-1,000	232,000	38,976	107,000		107,000	17,976	264,000	-1,000	233,000	39,144	2026
LSBH	0.239	-		-	-	-		30,000	7,170	-		-	-	-		30,000	7,176	
ESBH	0.054	35,000		35,000	1,890	56,200	0	56,200	3,035	39,700		39,700	2,144	56,600	0	56,600	3,056	
CU	0.054	47,500		47,500	2,565	40,600		40,600	2,192	41,000		41,000	2,214	40,600		40,600	2,192	
BH/CT	0.063	11,100		11,100	699	33,500		33,500	2,111	38,200		38,200	2,407	33,500		33,500	2,111	
C-T	0.072	146,000		146,000	10,512	138,000	-300	88,000	6336	114,000		114,000	8,208	138,000	-300	88,000	6,336	
C-T	0.072	-		-	-	-		50,000	3,600	-		-	-	-		50,000	3,600	
OL	0.042	197,000		197,000	8,274	19,000	-100	18,900	794	212,000		212,000	8,904	19,200	-100	19,100	802	
FM	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0.024	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.073	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.109	0		0	0	0		0	0	0		00	0	0		0	0	
Total					43,092				64,714				41,853				64,411	
LSBH	0.168	110,000		110,000	18,480	263,000	-1,000	232,000	38,976	102,000		102,000	17,136	264,000	-1,000	233,000	39,144	2036
LSBH	0.239	-		-	-	-		30,000	7,170	-		-	-	-		30,000	7,170	
ESBH	0.054	32,600		32,600	1,760	55,200	0	552,000	2,981	37,300		37,300	2,014	55,600	0	55,600	3,002	
CU	0.054	51,600		51,600	2,786	44,100		441,000	2,381	44,600		44,600	2,408	44,100		44,100	2,381	
BH/CT	0.063	11,700		11,700	737	35,700		357,000	2,249	41,000		41,000	2,583	35,700		35,700	2,249	
C-T	0.072	144,000		144,00	10,368	135,000	-30	85,000	6,120	109,000		109,000	7,848	135,000	-300	85,000	6,120	
C-T	0.072	-		-	-	-		-	-	-		-	-	-		50,000	3,600	
OL	0.042	203,000		203,000	8,526	19,200	-100	19,100	802	220,000		220,000	9,240	19,400	-100	19,300	811	
FM	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0.024	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.073	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
Total					42,657				64,279				33,381				64,477	

TABLE F-5-3

ATCHAFALAYA BASIN STUDY
FLOODWAY AND 1/4-MILE STRIP
IMPACTS OF PLAN ALTERNATIVES

	Waterfowl	Plan 2 (FWOP)				Plan 4 (EQ)				Plan 7 (NED)				Plan 9 (TS)				
Habitat Type	Hunting Carrying Capacity	Gross Acres	Adjusted Acres	Net Acres	User Day Supply	Gross Acres	Adjusted Acres	Net Acres	User Day Supply	Gross Acres	Adjusted Acres	Net Acres	User Day Supply	Gross Acres	Adjusted Acres	Net Acres	User Day Supply	Year
LSBH	0.003	253,000		253,000	759	260,000	-1,000	229,000	687	253,000		253,000	759	260,000	-1,000	229,000	687	1986
LSBH	0.005	-		-	-	-		30,000	150	-		-	-	-		30,000	150	
ESBH	0.003	73,800		73,800	221	76,300	0	76,300	229	73,800		73,800	221	76,300	0	76,300	229	
CU	0.003	6,400		6,400	19	5,500		5,500	17	6,400		6,400	19	5,500		5,500	17	
BH/CT	0.004	10,400		10,400	42	11,700		11,700	47	10,400		10,400	42	11,700		11,700	47	
C-T	0.005	173,000		173,000	865	171,000	-300	121,000	605	173,000		173,000	865	171,000	-300	121,000	605	
C-T	0.006	-		-	-	-		50,000	300	-		-	-	-		50,000	300	
OL	0	23,500		23,500	0	16,000	-100	15,900	0	23,500		23,500	0	16,000	-100	15,900	0	
FM	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0	0		0	0	0		0	0	0		0	0	0	0	0	0	
BM	0.001	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
Total					1,906				2,035				1,906				2,035	
LSBH	0.003	225,000		225,000	675	266,000	-1,000	235,000	705	224,000		224,000	672	266,000	-1,000	235,000	705	1996
LSBH	0.005	-		-	-	-		30,000	150	-		-	-	-		30,000	150	
ESBH	0.003	58,200		58,200	175	64,000	0	64,100	192	63,000		63,000	189	64,500	0	64,500	194	
CU	0.003	16,800		16,800	50	14,400		14,400	43	14,600		14,600	44	14,400		14,400	43	
BH/CT	0.004	12,400		12,400	50	17,100		17,100	68	22,900		22,900	92	17,100		17,100	68	
C-T	0.005	166,000		166,000	830	162,000	-300	112,000	560	154,000		154,000	770	162,000	-300	112,000	560	
C-T	0.006	-		-	-	-		50,000	300	-		-	-	-		50,000	300	
OL	0	61,600		61,600	0	16,800	-100	16,700	0	63,900		63,900	0	17,000	-100	169,000	0	
FM	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.001	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
Total					1780				2018				1767				2020	
LSBH	0.003	169,000		169,000	507	265,000	-1000	234,000	702	166,000		166,000	498	265,000	-1000	234,000	702	2006
LSBH	0.005							30,000	150							30,000	150	
ESBH	0.003	50,000		50,000	150	61,100	0	61,100	183	54,900		54,900	165	61,500	0	61,500	185	
CU	0.003	27,100		27,100	81	23,100		23,100	69	23,400		23,400	70	23,400		23,400	70	
BH/CT	0.004	11,400		11,400	46	22,600		22,600	90	27,600		27,600	110	22,600		22,600	90	
C-T	0.005	159,000		159,000	795	153,000	-300	103,000	515	140,000		140,000	700	153,000	-300	103,000	515	
C-T	0.006	-		-	-	-		50,000	300	-		-	-	-		50,000	300	
OL	0	127,000		127,000	0	17,800	-100	17,700	0	133,000		133,000	0	18,100	-100	18,000	0	
FM	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.001	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
Total					1579				2009				1543				2012	
LSBH	0.003	131,000		131,000	393	264,000	-1000	233,000	699	125,000		125,000	375	264,000	-1000	233,000	699	2016
LSBH	0.005	-		-	-	-		30,000	150	-		-	-	-		30,000	150	
ESBH	0.003	41,700		41,700	125	58,700	0	58,700	176	46,300		46,300	139	59,000	0	59,000	177	
CU	0.003	37,300		37,300	112	31,900		31,900	96	32,200		32,200	97	31,900		31,900	96	
BH/CT	0.004	10,400		10,400	42	28,100		28,100	112	31,900		31,900	128	28,100		28,100	112	
C-T	0.005	153,000		153,000	765	146,000	-300	96,000	480	127,000		127,000	635	146,000	-300	96,000	480	
C-T	0.006	-		-	-	-		50,000	300	-		-	-	-		50,000	300	
OL	0	174,000		174,000	0	18,400	-100	18,300	0	185,000		185,000	0	18,700	-100	18,600	0	
FM	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.001	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
Total					1437				2013				1374				2014	
LSBH	0.003	114,000		114,000	342	263,000	-1000	232,000	696	107,000		107,000	321	264,000	-1000	233,000	699	2026
LSBH	0.005	-		-	-	-		30,000	150	-		-	-	-		30,000	150	
ESBH	0.003	35,000		35,000	105	56,200	0	56,200	169	39,700		39,700	119	56,600	0	56,600	170	
CU	0.003	47,500		47,500	143	40,600		40,600	122	41,000		41,000	123	40,600		40,600	122	
BH/CT	0.004	11,100		11,100	44	33,500		33,500	134	38,200		38,200	153	33,500		33,500	134	
C-T	0.005	146,000		146,000	730	138,000	-300	88,000	440	114,000		114,000	570	138,000	-300	88,000	440	
C-T	0.006	-		-	-	-		50,000	300	-		-	-	-		50,000	300	
OL	0	197,000		197,000	0	19,000	-100	18,900	0	212,000		212,000	0	19,200	-100	19,100	0	
FM	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.001	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
Total					1364				2011				1286				2015	
LSBH	0.003	110,000		110,000	330	263,000	-1000	232,000	696	102,000		102,000	306	264,000	-1000	233,000	699	2036
LSBH	0.005	-		-	-	-		30,000	150	-		-	-	-		30,000	150	
ESBH	0.003	32,600		32,600	98	55,200	0	55,200	166	37,300		37,300	112	55,600	0	55,600	167	
CU	0.003	51,600		51,600	155	44,100		44,100	132	44,600		44,600	134	44,100		44,100	132	
BH/CT	0.004	11,700		11,700	47	35,700		35,700	143	41,000		41,000	164	35,700		35,700	143	
C-T	0.005	144,000		144,000	720	135,000	-300	85,000	425	109,000		109,000	545	135,000	-300	85,000	425	
C-T	0.006	-		-	-	-		50,000	300	-		-	-	-		50,000	300	
OL	0	203,000		203,000	0	19,200	-100	19,100	0	220,000		220,000	0	19,400	-100	19,300	0	
FM	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.001	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
Total					1350				2012				1261				2016	

TABLE F-5-4

ATCHAFALAYA BASIN STUDY
MARSH AND BACKWATER
IMPACTS OF PLAN ALTERNATIVES

Habitat Type	Big Game Hunting Carrying Capacity	Plan 2 (FWOP) Acres	Plan 2 (FWOP) User Day Supply	Plan 4 (EQ) Acres	Plan 4 (EQ) User Day Supply	Plan 7 (NED) Acres	Plan 7 (NED) User Day Supply	Plan 9 (TS) Acres	Plan 9 (TS) User Day Supply	Year
LSBH	0.209	84,100	17,577	84,100	17,577	84,100	17,577	84,100	17,577	1986
LSBH	0.539	-	-	-	-	-	-	-	-	
ESBH	0.124	2,800	347	2,800	347	2,800	347	2,800	347	
CU	0.124	0	0	0	0	0	0	0	0	
BH/CT	0.101	1,000	101	1,000	101	1,000	101	1,000	101	
C-T	0.077	274,000	21,098	274,000	21,098	274,000	21,098	274,000	21,098	
C-T	0.113	-	-	-	-	-	-	-	-	
OL	0	80,900	0	80,900	0	80,900	0	80,900	0	
FM	0.014	311,000	4,354	311,000	4,354	311,000	4,354	311,000	4,354	
SM	0	102,000	0	102,000	0	102,000	0	102,000	0	
BM	0	86,000	0	86,000	0	86,000	0	86,000	0	
D	0.014	25,000	350	25,000	350	25,000	350	25,000	350	
Total			43,827		43,827		43,827		43,827	
LSBH	0.209	82,200	17,180	81,800	17,096	77,200	16,135	81,800	17,096	1996
LSBH	0.539	-	-	-	-	-	-	-	-	
ESBH	0.124	2,700	335	3,400	422	4,900	608	4,900	608	
CU	0.124	0	0	0	0	0	0	0	0	
BH/CT	0.101	2,700	273	2,700	273	10,400	1,050	2,700	273	
C-T	0.077	273,000	21,021	273,000	21,021	255,000	19,635	273,000	21,021	
C-T	0.113	-	-	-	-	-	-	-	-	
OL	0	81,000	0	80,800	0	96,000	0	80,900	0	
FM	0.014	294,000	4,116	294,000	4,116	292,000	4,088	294,000	4,116	
SM	0	93,400	0	93,400	0	93,400	0	93,400	0	
BM	0	81,200	0	81,200	0	81,200	0	81,200	0	
D	0.014	49,900	699	49,900	699	41,900	587	49,900	699	
Total			43,600		43,627		42,103		43,813	
LSBH	0.209	80,400	16,804	80,800	16,887	76,100	15,905	80,000	16,720	2006
LSBH	0.539	-	-	-	-	-	-	-	-	
ESBH	0.124	2,600	322	3,300	409	4,800	595	4,800	595	
CU	0.124	0	0	0	0	0	0	0	0	
BH/CT	0.101	4,400	444	4,400	444	5,300	535	4,400	444	
C-T	0.077	272,000	20,944	273,000	21,021	255,000	19,635	273,000	21,021	
C-T	0.113	-	-	-	-	-	-	-	-	
OL	0	81,000	0	80,800	0	103,000	0	80,900	0	
FM	0.014	279,000	3,906	279,000	3,906	275,000	3,850	278,000	3,892	
SM	0	85,600	0	85,600	0	85,600	0	85,600	0	
BM	0	76,400	0	76,400	0	76,300	0	76,400	0	
D	0.014	74,900	1,049	74,900	1,049	74,400	1,042	74,900	1,049	
Total			43,469		43,716		41,562		43,721	
LSBH	0.209	78,700	16,448	78,300	16,365	75,600	15,800	78,300	16,365	2016
LSBH	0.539	-	-	-	-	-	-	-	-	
ESBH	0.124	2,600	322	3,300	409	4,800	595	4,800	595	
CU	0.124	0	0	0	0	0	0	0	0	
BH/CT	0.101	6,100	616	6,100	616	3,900	394	6,100	616	
C-T	0.077	272,000	20,944	273,000	21,021	255,000	19,635	273,000	21,021	
C-T	0.113	-	-	-	-	-	-	-	-	
OL	0	81,000	0	80,800	0	105,000	0	80,900	0	
FM	0.014	264,000	3,696	264,000	3,696	259,000	3,626	263,000	3,682	
SM	0	78,500	0	78,500	0	78,500	0	78,500	0	
BM	0	71,300	0	71,300	0	71,000	0	71,300	0	
D	0.014	100,000	1,400	100,000	1,400	98,400	1,378	100,000	1,400	
Total			43,426		43,507		41,428		43,679	
LSBH	0.209	77,000	16,093	76,600	16,009	75,600	15,800	76,600	16,009	2026
LSBH	0.539	-	-	-	-	-	-	-	-	
ESBH	0.124	2,600	332	3,300	409	4,800	595	4,800	595	
CU	0.124	0	0	0	0	0	0	0	0	
BH/CT	0.101	7,800	788	7,800	788	3,700	374	7,800	788	
C-T	0.077	271,000	20,867	273,000	21,021	255,000	19,635	273,000	21,021	
C-T	0.113	-	-	-	-	-	-	-	-	
OL	0	81,000	0	80,800	0	106,000	0	80,900	0	
FM	0.014	249,000	3,486	249,000	3,486	244,000	3,416	248,000	3,472	
SM	0	70,700	0	70,700	0	71,800	0	70,700	0	
BM	0	66,300	0	66,300	0	65,400	0	66,300	0	
D	0.014	125,000	1,750	125,000	1,750	122,000	1,708	125,000	1,750	
Total			43,316		43,463		41,528		43,635	
LSBH	0.209	76,300	15,947	75,900	15,863	75,600	15,800	75,900	15,863	2036
LSBH	0.539	-	-	-	-	-	-	-	-	
ESBH	0.124	2,600	322	3,300	409	4,800	595	4,800	595	
CU	0.124	0	0	0	0	0	0	0	0	
BH/CT	0.101	8,500	859	8,500	859	3,600	364	8,500	859	
C-T	0.077	271,000	20,867	273,000	21,021	255,000	19,635	273,000	21,021	
C-T	0.113	-	-	-	-	-	-	-	-	
OL	0	81,000	0	80,800	0	106,000	0	80,900	0	
FM	0.014	243,000	3,402	243,000	3,402	238,000	3,332	242,000	3,388	
SM	0	67,300	0	67,300	0	69,200	0	67,300	0	
BM	0	64,400	0	64,400	0	63,200	0	64,400	0	
D	0.014	135,000	1,890	135,000	1,890	131,000	1,834	135,000	1,890	
Total			43,287		43,444		41,560		43,616	

TABLE F-5-5

ATCHAFALAYA BASIN STUDY
MARSH AND BACKWATER
IMPACTS OF PLAN ALTERNATIVES

Habitat Type	Small Game Hunting Carrying Capacity	Plan 2 (FWOP) Acres	Plan 2 (FWOP) User Day Supply	Plan 4 (EQ) Acres	Plan 4 (EQ) User Day Supply	Plan 7 (NED) Acres	Plan 7 (NED) User Day Supply	Plan 9 (TS) Acres	Plan 9 (TS) User Day Supply	Year
LSBH	0.168	84,100	14,129	84,100	14,129	84,100	14,129	84,100	14,129	1986
LSBH	0.239	-	-	-	-	-	-	-	-	
ESBH	0.054	2,800	151	2,800	151	2,800	151	2,800	151	
CU	0.054	0	0	0	0	0	0	0	0	
BH/CT	0.063	1,000	63	1,000	63	1,000	63	1,000	63	
C-T	0.072	274,000	19,728	274,000	19,728	274,000	19,728	274,000	19,728	
C-T	0.072	-	-	-	-	-	-	-	-	
OL	0.042	80,900	3,398	80,900	3,398	80,900	3,398	80,900	3,398	
FM	0.109	311,000	33,899	311,000	33,899	311,000	33,899	311,000	33,899	
SM	0.024	102,000	2,448	102,000	2,448	102,000	2,448	102,000	2,448	
BM	0.073	86,000	6,278	86,000	6,278	86,000	6,278	86,000	6,278	
D	0.109	25,000	2,725	25,000	2,725	25,000	2,725	25,000	2,725	
Total			82,819		82,819		82,819		82,819	
LSBH	0.168	82,200	13,810	81,800	13,742	77,200	12,970	81,800	13,742	1996
LSBH	0.239	-	-	-	-	-	-	-	-	
ESBH	0.054	2,700	146	3,400	184	4,900	265	4,900	265	
CU	0.054	0	0	0	0	0	0	0	0	
BH/CT	0.063	2,700	170	2,700	170	10,400	655	2,700	170	
C-T	0.072	273,000	19,656	273,000	19,656	255,000	18,360	273,000	19,656	
C-T	0.072	-	-	-	-	-	-	-	-	
OL	0.042	81,000	3,402	80,800	3,398	96,000	4,032	80,900	3,398	
FM	0.109	294,000	32,046	294,000	32,046	292,000	31,828	294,000	32,046	
SM	0.024	93,400	2,242	93,400	2,242	93,400	2,242	93,400	2,242	
BM	0.073	81,200	5,928	81,200	5,928	81,200	5,928	81,200	5,928	
D	0.109	49,900	5,439	49,900	5,439	41,900	4,567	49,900	5,439	
Total			82,839		82,805		80,847		82,886	
LSBH	0.168	80,400	13,507	80,800	13,574	76,100	12,785	80,000	13,440	2006
LSBH	0.239	-	-	-	-	-	-	-	-	
ESBH	0.054	2,600	140	3,300	178	4,800	259	4,800	259	
CU	0.054	0	0	0	0	0	0	0	0	
BH/CT	0.063	4,400	277	4,400	277	5,300	334	4,400	277	
C-T	0.072	272,000	19,584	273,000	19,656	255,000	18,360	273,000	19,656	
C-T	0.072	-	-	-	-	-	-	-	-	
OL	0.042	81,000	3,402	80,800	3,398	103,000	4,326	80,900	3,398	
FM	0.109	279,000	30,411	279,000	30,411	275,000	29,975	278,000	30,302	
SM	0.024	85,600	2,054	85,600	2,054	85,600	2,054	85,600	2,054	
BM	0.073	76,400	5,577	76,400	5,577	76,300	5,570	76,400	5,577	
D	0.109	74,900	8,164	74,900	8,164	74,400	8,110	74,900	8,164	
Total			83,116		83,289		81,773		83,127	
LSBH	0.168	78,700	13,222	78,300	13,154	75,600	12,701	78,300	13,154	2016
LSBH	0.239	-	-	-	-	-	-	-	-	
ESBH	0.054	2,600	140	3,300	178	4,800	259	4,800	259	
CU	0.054	0	0	0	0	0	0	0	0	
BH/CT	0.063	6,100	384	6,100	384	3,900	246	6,100	384	
C-T	0.072	272,000	19,584	273,000	19,656	255,000	18,360	273,000	19,656	
C-T	0.072	-	-	-	-	-	-	-	-	
OL	0.042	81,000	3,402	80,800	3,398	105,000	4,410	80,900	3,398	
FM	0.109	264,000	28,776	264,000	28,776	259,000	28,231	263,000	28,667	
SM	0.024	78,500	1,884	78,500	1,884	78,500	1,884	78,500	1,884	
BM	0.073	71,300	5,205	71,300	5,205	71,000	5,183	71,300	5,205	
D	0.109	100,000	10,900	100,000	10,900	98,400	10,726	100,000	10,900	
Total			83,497		83,535		82,000		83,507	
LSBH	0.168	77,000	12,936	76,600	12,869	75,600	12,701	76,600	12,869	2026
LSBH	0.239	-	-	-	-	-	-	-	-	
ESBH	0.054	2,600	140	3,300	178	4,800	259	4,800	259	
CU	0.054	0	0	0	0	0	0	0	0	
BH/CT	0.063	7,800	491	7,800	491	3,700	233	7,800	491	
C-T	0.072	271,000	19,512	273,000	19,656	255,000	18,360	273,000	19,656	
C-T	0.072	-	-	-	-	-	-	-	-	
OL	0.042	81,000	3,402	80,800	3,398	106,000	4,452	80,900	3,398	
FM	0.109	249,000	27,141	249,000	27,141	244,000	26,596	248,000	27,032	
SM	0.024	70,700	1,697	70,700	1,697	71,800	1,723	70,700	1,697	
BM	0.073	66,300	4,840	66,300	4,840	65,400	4,774	66,300	4,840	
D	0.109	125,000	13,625	125,000	13,625	122,000	13,298	125,000	13,625	
Total			83,784		83,895		82,396		83,867	
LSBH	0.168	76,300	12,818	75,900	12,751	75,600	12,701	75,900	12,751	2036
LSBH	0.239	-	-	-	-	-	-	-	-	
ESBH	0.054	2,600	140	3,300	178	4,800	259	4,800	259	
CU	0.054	0	0	0	0	0	0	0	0	
BH/CT	0.063	8,500	536	8,500	536	3,600	227	8,500	536	
C-T	0.072	271,000	19,512	273,000	19,656	255,000	18,360	273,000	19,656	
C-T	0.072	-	-	-	-	-	-	-	-	
OL	0.042	81,000	3,402	80,800	3,398	106,000	4,452	80,900	3,398	
FM	0.109	243,000	26,487	243,000	26,487	238,000	25,942	242,000	26,378	
SM	0.024	67,300	1,615	67,300	1,615	69,200	1,661	67,300	1,615	
BM	0.073	64,400	4,701	64,400	4,701	63,200	4,614	64,400	4,701	
D	0.109	135,000	14,715	135,000	14,715	131,000	14,279	135,000	14,715	
Total			83,926		84,037		82,495		84,009	

TABLE F-5-6

ATCHAFALAYA BASIN STUDY
MARSH AND BACKWATER
IMPACTS OF PLAN ALTERNATIVES

Habitat Type	Waterfowl Hunting Carrying Capacity	Plan 2 (FWOP) Acres	Plan 2 (FWOP) User Day Supply	Plan 4 (EQ) Acres	Plan 4 (EQ) User Day Supply	Plan 7 (NED) Acres	Plan 7 (NED) User Day Supply	Plan 9 (TS) Acres	Plan 9 (TS) User Day Supply	Year
LSBH	0.003	84,100	252	84,100	252	84,100	252	84,100	252	1986
LSBH	0.005	-	-	-	-	-	-	-	-	
ESBH	0.003	2,800	8	2,800	8	2,800	8	2,800	8	
CU	0.003	0	0	0	0	0	0	0	0	
BH/CT	0.004	1,000	4	1,000	4	1,000	4	1,000	4	
C-T	0.005	274,000	1,370	274,000	1,370	274,000	1,370	274,000	1,370	
C-T	0.006	-	-	-	-	-	-	-	-	
OL	0	80,900	0	80,900	0	80,900	0	80,900	0	
FM	0.001	311,000	622	311,000	622	311,000	622	311,000	622	
SM	0	102,000	0	102,000	0	102,000	0	102,000	0	
BM	0.001	86,000	86	86,000	86	86,000	86	86,000	86	
D	0.002	25,000	50	25,000	50	25,000	50	25,000	50	
Total			2,392		2,392		2,392		2,392	
LSBH	0.003	82,200	247	81,800	245	77,200	232	81,800	245	1996
LSBH	0.005	-	-	-	-	-	-	-	-	
ESBH	0.003	2,700	8	3,400	10	4,900	15	4,900	15	
CU	0.003	0	0	0	0	0	0	0	0	
BH/CT	0.004	2,700	11	2,700	11	10,400	42	2,700	11	
C-T	0.005	273,000	1,365	273,000	1,365	255,000	1,275	273,000	1,365	
C-T	0.006	-	-	-	-	-	-	-	-	
OL	0	81,000	0	80,800	0	96,000	0	80,900	0	
FM	0.002	294,000	588	294,000	588	292,000	584	294,000	588	
SM	0	93,400	0	93,400	0	93,400	0	93,400	0	
BM	0.001	81,200	81	81,200	81	81,200	81	81,200	81	
D	0.002	49,900	100	49,900	100	41,900	84	49,900	100	
Total			2,400		2,400		2,313		2,405	
LSBH	0.003	80,400	241	80,800	242	76,100	228	80,000	240	2006
LSBH	0.005	-	-	-	-	-	-	-	-	
ESBH	0.003	2,600	8	3,300	10	4,800	14	4,800	14	
CU	0.003	0	0	0	0	0	0	0	0	
BH/CT	0.004	4,400	18	4,400	18	5,300	21	4,400	18	
C-T	0.005	272,000	1,360	273,000	1,365	255,000	1,275	273,000	1,365	
C-T	0.006	-	-	-	-	-	-	-	-	
OL	0	81,000	0	80,800	0	103,000	0	80,900	0	
FM	0.002	279,000	558	279,000	558	275,000	550	278,000	556	
SM	0	85,600	0	85,600	0	85,600	0	85,600	0	
BM	0.001	76,400	76	76,400	76	76,300	76	76,400	76	
D	0.002	74,900	150	74,900	150	74,400	149	74,900	150	
Total			2,411		2,419		2,313		2,419	
LSBH	0.003	78,700	236	78,300	235	75,600	227	78,300	235	2016
LSBH	0.005	-	-	-	-	-	-	-	-	
ESBH	0.003	2,600	8	3,300	10	4,800	14	4,800	14	
CU	0.003	0	0	0	0	0	0	0	0	
BH/CT	0.004	6,100	24	6,100	24	3,900	16	6,100	24	
C-T	0.005	272,000	1,360	273,000	1,365	255,000	1,275	273,000	1,365	
C-T	0.006	-	-	-	-	-	-	-	-	
OL	0	81,000	0	80,800	0	105,000	0	80,900	0	
FM	0.002	264,000	528	264,000	528	259,000	518	263,000	526	
SM	0	78,500	0	78,500	0	78,500	0	78,500	0	
BM	0.001	71,300	71	71,300	71	71,000	71	71,300	71	
D	0.002	100,000	200	100,000	200	98,400	197	100,000	200	
Total			2,427		2,433		2,318		2,435	
LSBH	0.003	77,000	231	76,600	230	75,600	227	76,600	230	2026
LSBH	0.005	-	-	-	-	-	-	-	-	
ESBH	0.003	2,600	8	3,300	10	4,800	14	4,800	14	
CU	0.003	0	0	0	0	0	0	0	0	
BH/CT	0.004	7,800	31	7,800	31	3,700	15	7,800	31	
C-T	0.005	271,000	1,355	273,000	1,365	255,000	1,275	273,000	1,365	
C-T	0.006	-	-	-	-	-	-	-	-	
OL	0	81,000	0	80,800	0	106,000	0	80,900	0	
FM	0.002	249,000	498	249,000	498	244,000	488	248,000	496	
SM	0	70,700	0	70,700	0	71,800	0	70,700	0	
BM	0.001	66,300	66	66,300	66	65,400	65	66,300	66	
D	0.002	125,000	250	125,000	250	122,000	244	125,000	250	
Total			2,439		2,450		2,328		2,452	
LSBH	0.003	76,300	229	75,900	228	75,600	227	75,900	228	2036
LSBH	0.005	-	-	-	-	-	-	-	-	
ESBH	0.003	2,600	8	3,300	10	4,800	14	4,800	14	
CU	0.003	0	0	0	0	0	0	0	0	
BH/CT	0.004	8,500	34	8,500	34	3,600	14	8,500	34	
C-T	0.005	271,000	1,355	273,000	1,365	255,000	1,275	273,000	1,365	
C-T	0.006	-	-	-	-	-	-	-	-	
OL	0	81,000	0	80,800	0	106,000	0	80,900	0	
FM	0.002	243,000	486	243,000	486	238,000	476	242,000	484	
SM	0	67,300	0	67,300	0	69,200	0	67,300	0	
BM	0.001	64,400	64	64,400	64	63,200	63	64,400	64	
D	0.002	135,000	270	135,000	270	131,000	262	135,000	270	
Total			2,446		2,457		2,331		2,459	

TABLE F-5-7

ATCHAFALAYA BASIN STUDY
PLAN ALTERNATIVE ASSESSMENT
RECREATION USER DAY SUMMARY WITH ASSOCIATED ANNUAL DOLLAR VALUES

	FWOP		EQ		NED		TS		Recommended	
	User Days		User Days		User Days		User Days		User Days	
Area	1980	2030	1980	2030	1980	2030	1980	2030	1980	2030
Floodway	140,000	89,800	140,000	156,000	140,000	78,700	140,000	156,000	140,000	168,000
Marsh/Backwater	129,000	130,000	129,000	130,000	129,000	126,000	129,000	130,000	129,000	130,000
Floodway/Proposed Rec Plan	0	0	0	1,255,000	0	1,026,000	0	1,255,000	0	1,026,000
Totals	269,000	220,000	269,000	1,541,000	269,000	1,231,000	269,000	1,541,000	269,000	1,324,000

	FWOP		EQ		NED		TS		Recommended	
	Dollar Value		Dollar Value		Dollar Value		Dollar Value		Dollar Value	
Area	1980	2030	1980	2030	1980	2030	1980	2030	1980	2030
Floodway	4,221,000	2,622,000	4,221,000	4,777,000	4,221,000	2,393,000	4,221,000	4,792,000	4,221,000	5,222,000
Marsh/Backwater	3,248,000	3,247,000	3,248,000	3,255,000	3,248,000	3,151,000	3,248,000	3,263,000	3,248,000	3,263,000
Floodway/Proposed Rec Plan	0	0	0	17,273,000	0	16,551,000	0	17,273,000	0	16,551,000
Totals	7,469,000	5,869,000	7,469,000	25,305,000	7,469,000	22,095,000	7,469,000	25,328,000	7,469,000	25,036,000

utilization of regional or site-specific use estimating models; however, the use of either of these methods is contingent upon sufficient base data. No regional use estimating model exists for any area of Louisiana, nor is there a site specific use estimator model (UEM) for the Atchafalaya Basin. Available data on use determining variables were inadequate and were neither time effective nor cost effective to obtain. The application of a similar project's method to derive a UEM for the Atchafalaya Basin was rejected as no similar project exists having adequate surveys and observations from which to extrapolate applicable per capita use rates. As sufficient excess demand was exhibited in the market area, the next preferred method, the capacity method of determining recreation use was employed. The capacity use methodology as it applies to this study is described previously in this section.

F.5.23. Although the existing data was inadequate in providing a basis for forecasting total use, it did serve its intended purpose in providing a basis for determining the site-specific worth of a recreation user day for various activity types. The base data analysis and results are contained in "Recreational Benefits for the Atchafalaya River Basin," F.W. Bell, 1981. This report is detailed in Appendix D. For comparative purposes, the values from Bell's Report (Updated to October 1981 prices), which are in this study, and the value ranges for recreation unit days contained in the WRC Principles and Standards (P&S) are displayed as follows:

	Bell Study ($)	P&S ($)
Bank Fishing	3.14	2.20 - 4.50
Pier Fishing	3.14	2.20 - 4.50
Crabbing	3.14	2.20 - 4.50
Crawfishing	3.14	2.20 - 4.50
General Recreation	7.42	1.50 - 4.50
Boat Fishing	35.79	2.20 - 4.50
Big Game Hunting	40.78	10.50 - 17.90
Small Game Hunting	16.89	2.20 - 4.50
Waterfowl Hunting	26.58	2.20 - 4.50

F.5.24. The total user-days and associated dollar values for each plan alternative are summarized in Table F-5-7. in addition, each plan alternative is addressed with respect to base conditions and compared with the future without-project when impacts due to major project features are assessed.

IMPACT ASSESSMENT AND COMPARATIVE ANALYSIS OF PLANS

Future Without-Project Conditions - Impacts Due to Major Project Features

F.5.25. 1980-2030. Under the future without-project conditions as compared with the 1980 base conditions, 140,000 existing annual recreation user-days would be reduced to 89,800 annual user-days in the floodway, and 129,000 existing annual recreation user-days would be increased to 130,000 annual user-days in the marsh/backwater area by the year 2030. These figures represent annual losses of $1,599,000 and $1,000, respectively. Losses in the floodway can be attributed to the clearing of forested lands for agricultural purposes; and marsh losses can be attributed to the natural process of ongoing marsh deterioration. Under future without-project conditions, a shift in usage from big game hunting to small game hunting will occur. Although an overall gain in user-days would be realized, the unit day value differential would be too great to prevent an overall net annual monetary loss.

F.5.26. 2030. Data are not available to forecast conditions beyond 2030, but if land clearing continues throughout the project life, at least 25,000 additional acres would be cleared by 2080, resulting in an additional loss of 9,500 annual recreation user-days worth $286,000.

EQ Plan - Impacts Due to Major Project Features

F.5.27. 1980-2030. Under this plan, compared with the 1980 base conditions, 140,000 existing annual recreation user-days would be increased to 156,000 annual user-days in the floodway, and 129,000 annual recreation user-days would be increased to 130,000 annual user-days in the marsh/backwater area by the year 2030. These figures represent annual gains of $556,000 and $7,000, respectively, for that year. Increases in the amount of user-days in the floodway can be attributed to the real estate features of the plan, which prevent land clearing and provide for public access to large tracts of prime lands that will be managed to enhance recreation use potential. Increase in the marsh/backwater area can be attributed to the preclusion of clearing of forestlands in the backwater and to vegetative succession of lands to a higher carrying capacity use. When compared with figures for the future without-project conditions (2030), this plan alternative reflects a net annual increase of 66,200 user-days worth $2,155,000 for the floodway and a net annual increase of 300 user-days worth $8,000 for the marsh/backwater area. In addition, the proposed recreational development features of this plan would provide a net increase of 1,237,000 annual user-days for the floodway and 18,000 for the marsh/backwater. The total of these user-days has a combined annual net worth of $17,273,000.

F.5.28. 2030-2080. Data are not available to forecast exact conditions beyond the year 2030, but if trends occurring at that time continue into the future, recreation use potential in the floodway will increase slightly over time through the remaining project life. This increase will result from the natural succession of certain habitat type acreage to a type with higher recreational use potential. Marsh acreage will, however, continue to decline, lowering its associated user-day potentials. Because much land outside the floodway in the region will be cleared for agricultural purposes, the nonconsumptive recreation use potential in the floodway will probably increase because of the nonavailability of the resource elsewhere. Use occurring on the developed recreational features proposed by this plan would remain constant and at optimal design carrying capacity levels, based upon projected market area need for the initial construction year.

NED Plan - Impacts Due to Major Project Features

F.5.29. 1980-2030. Under the NED plan, compared with the 1980 base conditions, 140,000 existing annual recreation user-days would be decreased to 78,700 annual user-days in the floodway, and 129,000 annual user-days would be decreased to 126,000 annual user-days in the marsh/backwater area by the year 2030. These figures represent annual losses of $1,828,000 and $97,000, respectively, for that year. Losses in the floodway can be attributed to extensive clearing of forested lands for agricultural purposes. Marsh/backwater area losses can be attributed to clearing of forested lands for agricultural purposes in the backwater area, to the natural process of ongoing marsh deterioration, and to the Avoca Island levee extension alinement, which would directly interfere with delta development. When compared with figures for the future without-project figures (2030), this plan alternative reflects a net annual decrease of 11,100 user-days worth $229,000 for the floodway, and a net annual decrease of 4,000 user-days worth $96,000 for the marsh/backwater area. The proposed recreational development feature of this plan would occur on fee simple land, maximizing national economic development. A net annual increase of 1,026,000 recreation user-days worth $16,551,000 would be provided. The increases for this plan are less than for other plan alternatives as no visitation is calculated for activities occurring on easement lands which account for 229,000 annual user days in the other plan alternatives.

F.5.30. 2030-2080. Data are not available to accurately forecast conditions beyond the year 2030, but if land clearing continues throughout the remainder of the project life, at least 25,000 additional acres of forestland would be cleared, resulting in an additional loss of 9,500 annual recreation user-days worth $286,000.

TS Plan - Impacts Due to Major Project Features

F.5.31. 1980-2030. Same as discussed under EQ plan.

F.5.32. 2030-2080. Same as discussed under EQ plan.

Recommended Plan - Impacts Due to Major Project Features

F.5.33. 1980-2030. When compared with the 1980 base conditions, the recommended plan would increase 140,000 annual recreation user-days to 168,000 annual recreation user-days in the floodway, and 129,000 annual recreation user-days to 130,000 annual recreation user-days in the marsh/backwater area by the year 2030. These figures represent annual gains of $1,001,000 and $15,000 respectively, for that year. The reasons for these increases are the same as those discussed under the EQ plan. When compared with figures for the future without-project conditions (2030), this plan alternative reflects a net annual increase of 78,200 user days worth $2,600,000 for the floodway and a net annual increase of 500 user-days worth $16,000 for the marsh/backwater area. The impacts of the recreational development plan are identical to those discussed under the NED plan.

F.5.34. 2030-2080. Same as under EQ plan.

Section 6 - RECREATION DEVELOPMENT BENEFIT - COST ANALYSIS

COSTS

F.6.1. A cost estimate summary in 1981 dollars for the initial development of each recreational site as based upon facilities proposed for each site is shown in Table F-6-1. A contingency factor of 25 percent has been included, as well as 12 percent for engineering and design costs, and 13 percent for supervision and administration related to the construction of recreational facilities. Land costs are also included. Two percent of the total first costs, exclusive of land costs, was used for estimating annual operation, maintenance and replacement costs. The operation, maintenance and replacement (O&M) costs will be borne by the local sponsor, which is the State of Louisiana. These costs apply only to the O&M of the recreational facilities proposed for development on the 1,500 acres of proposed fee land. Because of the difficulty in estimating actual O&M costs that would be incurred by the State of Louisiana regarding its manpower capabilities, existing equipment inventories, salary requirements, etc., a 2 percent assessment of the total separable first costs of recreational facilities development, exclusive of land acquisition costs, was used to calculate the estimated annual O&M costs. This 2 percent figure is consistent with approved estimated O&M costs used for other US Army Corps of Engineers' water resource development projects having similar recreational development administered by non-Federal entities. Costs reflected in Table F-6-1 are associated with the development of recreational facilities on land acquired in fee simple and are, therefore, applicable to all plan alternatives being considered, except future without-project conditions.

BENEFITS

F.6.2. To calculate benefits for the recommended recreational development features, user-day values listed in Section 5 of this appendix were applied to projected annual use figures for the activity types of each plan alternative to arrive at an annual total dollar figure. Table F-6-2 shows these computations for all plans under consideration. Plans 4 (EQ) and 9 (TS) are identical in that they accrue benefits from use occurring on both fee and easement land, whereas Plan 7 (NED) and the recommended plan differ from Plans 4 and 9 by incorporating a level of development that can occur only on land purchased in fee simple to maximize national economic development.

TABLE F-6-1

ATCHAFALAYA BASIN STUDY
COST ESTIMATE SUMMARY FOR PROPOSED RECREATIONAL DEVELOPMENT
(DOLLARS IN THOUSANDS)

Site Development Type		Subtotal 1	25% Contingencies	Net Total	12% E&D	13% S&A	Subtotal 2	Real Estate	Grand Total	Annual O&M & Replacement
Campground (Dev)	A	1,747.77	437.23	2,185.00	262.20	284.05	2,731.25			2% of subtotal 2
	B	2,190.75	547.98	2,738.44	328.61	355.99	3,423.04			
	C	1,734.32	433.44	2,167.75	260.25	281.87	2,709.86			
Campground (Prim)	D	91.43	22.77	114.28	13.80	14.84	142.95			
	E	91.43	22.77	114.28	13.80	14.84	142.95			
	F	91.43	22.77	114.28	13.80	14.84	142.95			
	G	91.43	22.77	114.28	13.80	14.84	142.95			
	H	91.43	22.77	114.28	13.80	14.84	142.95			
	I	91.43	22.77	114.28	13.80	14.84	142.95			
	J	91.43	22.77	114.28	13.80	14.84	142.95			
Interpretive Facility	K	560.05	140.30	700.35	84.07	91.08	875.50			
Boat-launching Area two-lane	L	322.00	80.50	402.50	48.30	52.33	503.13			
	M	322.00	80.50	402.50	48.30	52.33	503.13			
Boat-launching Area five-lane	N	402.50	100.63	503.13	60.38	65.55	629.05			
	O	402.50	100.63	503.13	60.38	65.55	629.05			
	P	402.50	100.63	503.13	60.38	65.55	629.05			
	Q	402.50	100.63	503.13	60.38	65.55	629.05			
	R	402.50	100.63	503.13	60.38	65.55	629.05			
	S	402.50	100.63	503.13	60.38	65.55	629.05			
Boat-launching Area two-lane	T	322.00	80.5	402.50	48.30	52.33	503.13			
	U	322.00	80.5	402.50	48.30	52.33	503.13			
Boat-launching Area five-lane	V	402.50	100.63	503.13	60.38	65.55	629.05			
Boat-launching Area two-lane	W	322.00	80.50	402.50	48.30	52.33	503.13			
	X	322.00	80.50	402.50	48.30	52.33	503.13			
	Y	322.00	80.50	402.50	48.30	52.33	503.13			
	Z	322.00	80.50	402.50	48.30	52.33	503.13			
Totals		12,266.36		15,333.41			19,168.61	1,187.00[1/]	20,355.61	383.37

[1/] $1,187,000 is the fee acquisition cost of 1,500 acres excluding comprehensive basin-wide easements. When such easements are assumed in place, the incremental cost of acquiring the 1,500 acres would be $874,000. These figures are used in the cost computations of their associated plan alternative.

TABLE F-6-2

ATCHAFALAYA BASIN STUDY
Dollar Benefit Calculations for Proposed Recreational Features

	EQ and TS Plans			NED and Recommended Plans		
Recreational Activities	Annual Visitation	User Day Value	Dollar Benefits	Annual Visitation	User Day Value	Dollar Benefits
General Recreation	705,468	7.42	5,235,000	705,648	7.42	5,235,000
Fishing (Boat)	315,828	35.79	11,303,000	315,828	35.79	11,303,000
Fishing (Other)	233,997	3.14	735,000	4,230	3.14	13,000
Grand Totals	1,255,293		17,273,000	1,025,706		16,551,000

Therefore, use attributed to those activities occurring on nonfee land is precluded from the NED plan and the recommended plan, and user-days and benefits will be deducted for these activities under these plan alternatives.

BENEFITS AND COSTS

F.6.3. For the EQ and TS plans, the following benefit-cost computations are applicable:

Total First Cost of Construction	$21,571,000[1]
Interest and Amortization Factor (100-year, 7-5/8 percent)	0.0763
Annual Interest and Amortization	$ 1,645,867
Annual Interest and Amortization	$ 1,646,000 (rounded)
Annual Operational and Maintenance Costs	383,000
Total Annual Costs	$ 2,029,000
Annual Benefits / Annual Costs	$17,273,000 / $ 2,029,000 = 8.5 to 1

F.6.4. The benefit-cost ratio of the proposed recreational development features of the EQ and TS plans is 8.5 to 1.

F.6.5. For the NED plan, the following computations are applicable:

Total First Cost of Construction	$21,908,000[2]
Interest and Amortization Factor (100-year, 7-5/8 percent)	0.0763
Annual Interest and Amortization	$ 1,671,580
Annual Interest and Amortization	$ 1,672,000 (rounded)
Annual Operation and Maintenance Costs	383,000
Total Annual Costs	$ 2,055,000
Annual Benefits / Annual Costs	$16,551,000 / $ 2,055,000 = 8.1 to 1

[1]Includes $1,528,000 for interest during construction.
[2]Includes $1,552,000 for interest during construction.

F.6.6. The benefit-cost ratio of the proposed recreational development features of the NED plan is 8.1 to 1.

F.6.7. For the recommended plan, the following computations are applicable:

Total First Cost of Construction	$21,571,000[1/]
Interest and Amortization Factor (100-year, 7-5/8 percent)	0.0763
Annual Interest and Amortization	$ 1,645,867
Annual Interest and Amortization	$ 1,646,000 (rounded)
Annual Operational and Maintenance Costs	383,000
Total Annual Costs	$ 2,029,000
Annual Benefits / Annual Costs	$16,551,000 / $ 2,029,000 = 8.2 to 1

F.6.8. The benefit-cost ratio of the proposed recreational development features of the recommended plan is 8.2 to 1.

F.6.9. These benefit-cost ratios are derived solely for the proposed recreational development features of each plan alternative. There are, however, other recreation benefits or losses that occur from shifts in land-use caused by the other varying features of each plan alternative. These recreation benefits or losses have been identified and monetarily calculated in Section 5 of this appendix addressing plan alternative assessment; however, recreation impacts are only one of several impacts attributable to the various features of a respective plan alternative and cannot be considered apart from the other impacts of that plan, nor can they generate a benefit-cost ratio.

[1/] Includes $1,528,000 for interest during construction.

Section 7 - RECREATION AND RESOURCE MANAGEMENT

MANAGEMENT RESPONSIBILITIES

F.7.1. All costs associated with acquiring real estate interests and with constructing the initial recreation facilities development as proposed herein for the Atchafalaya Basin floodway project will be at 100-percent Federal expense, provided that the State of Louisiana assumes all costs for management, administration, operation, maintenance, and future replacements. Revenues generated through campground user fees, entrance fees, or other incidental fees associated with operation of developed public recreation facilities, public access areas, and supporting third-party concessions will be retained by the state under appropriate lease agreement, subject to Federal regulations and reporting requirements, to help defray expenses for operations, maintenance, and replacements. Also, revenues generated through timber harvesting solely for the purpose of improving wildlife habitat on forested lands that may be under Federal ownership, as defined in appropriate license agreement, will be retained by the state for use in the development, conservation, maintenance, and utilization of such lands for fish and wildlife purposes.

F.7.2. All costs for constructing and maintaining offices, shops, storage, or other buildings, and for operations and maintenance including, but not limited to, automobiles, utility vehicles, trucks, boats, tools, machinery, heavy and light construction equipment, fences, signs, roads, parking areas, utilities, potable water and sanitary systems, and any other physical plant, personnel, or equipment incidental to or associated with the management, administration, operation, maintenance, and replacement of developed public recreation facilities and public land and water resources in the Atchafalaya Basin will be borne by the State of Louisiana.

COST SHARING

F.7.3. For purposes of determining Federal-state cost-sharing responsibilities, the Atchafalaya Basin is not a traditional water resources development project. Thus, the project should be considered exempt from the traditional policies, the President's cost-sharing policy, and provisions of PL 89-72, 89th Congress, S. 1229, 9 July 1965 under Section 6(e), which states in part that "cost-sharing and reimbursement provisions of the Act shall not apply to nonreservoir local flood control projects," beach erosion control projects, small boat harbor projects, hurricane protection projects, "or to project areas or facilities authorized by law for inclusion within a national recreation area or appropriate for administration by a Federal agency" as part of a national forest system, as part of the public lands classified for retention in Federal ownership, "or in connection with an authorized Federal program for the conservation and development of fish and wildlife." The pre-authorization study was authorized by both the House of Representatives and the Senate of the United States, as cited under Study Authority in Appendix A, i.e., "developing a comprehensive plan for the management and preservation of the water and related land resources of the Atchafalaya River Basin, Louisiana, which would include...improvements of the area for commercial and sport fishing..."

F.7.4. The Atchafalaya Basin floodway is a nonreservoir flood control project, but goes far beyond the scope of a local project. The project areas or facilities may become authorized by law to satisfy the intent of the study authority resolution, which directs management and preservation of the basin's natural resources, including improvements for public recreational purposes, i.e., sport fishing, as well a commercial fishing potential. The nonflood control aspects of the project are considered appropriate for administration by a Federal or state agency. In view of the administrative policy of placing more responsibility for the operation and maintenance of water resource projects in the hands of local authorities, it is proposed that the State of Louisiana take responsibility for operation and maintenance of management units, recreational development and any lands acquired for public access. Flood control features, dredge and fill (404 and Section 10), and real estate management of Federally acquired rights or interests will remain under the control of the US Army Corps of Engineers through appropriate license or lease agreements with the state.

F.7.5. Lands of the Atchafalaya Basin are not part of a national forest system. However, further justification for exemption of the Atchafalaya Basin floodway from cost-sharing requirements may be based on the basin's national environmental prominence as the largest existing forested wetland (river swamp) in the United States today that remains in a semi-natural state. The charge for preservation of this vast national resource, while maximizing public opportunity to observe and use its fish and wildlife resources, is clearly beyond the scope of traditional US Army Corps of Engineers' water resource development projects. The Governor of the State of Louisiana, in the state's Land Use Proposal, transmitted by letter 5 November 1980 to the District Engineer, recommended that "...management of nonflood control elements of the final Atchafalaya Basin plan should be through State of Louisiana agencies". This appears to more than satisfy previous legislative and executive intent for assuring local cooperation and participation in Federal flood control projects.

RECREATIONAL LANDS AND FACILITIES

F.7.6. Section 221 of the Flood Control Act of 1970 requires that the construction of any water resources project by the Secretary of the Army acting through the Chief of Engineers, shall not be commenced until each non-Federal interest has entered into a written agreement with the Secretary of the Army to furnish its required cooperation for the project. Consistent with this section of the Act, it is the intent of the District Engineer to lease all lands acquired for recreational development purposes in the Lower Atchafalaya Basin floodway project to the State of Louisiana for the purpose of administration, operation, maintenance, replacement, and future development to fulfill that cooperative requirement. The previously alluded to Land Use Proposal letter of 5 November 1980, from the Governor of the State of Louisiana, will serve as the letter of intent for assuring local cooperation and participation in the management of nonflood control elements of this Federal flood control project. A copy of the referenced letter is contained as an inclosure in Appendix B.

F.7.7. Terms and conditions of the lease(s) shall be in accordance with policies and procedures under statutory authority of Section 4 of the Act of Congress, approved 22 December 1944, as amended (16 U.S.C. 460-d).

F.7.8. The consideration for such lease(s) is the assumption by the state of the obligations imposed by terms of the lease to provide the services and facilities required to serve the general public in the leased area(s).

OTHER LANDS

F.7.9. For other lands on which Federal easements are acquired in the Atchafalaya Basin floodway project, it is the intent of the District Engineer to license such lands to the State of Louisiana for management, operation, and maintenance for public interests other than public park and recreational purposes.

F.7.10. Terms and conditions of the license(s) shall be in accordance with policies and procedures under statutory authority of Section 4 of the Act of Congress, approved 22 December 1944, as amended (76 Stat. 1195; 16 U.S.C. 460-d). The Fish and Wildlife Coordination Act and the Act of 22 December 1944, as amended, will both be invoked for the grant of a license for fish and wildlife management as well as forest management.

F.7.11. Monetary consideration is not required for the granting of such license.

MANAGMENT ENTITY, STATE

F.7.12. Under the envisioned state management concept, several different state departments will have responsibilities within the Lower Atchafalaya Basin floodway for administration, operations, and maintenance of the basin's developed and natural resources. Thus, the state should consider establishing a single management entity or authority, sufficiently staffed to effectively coordinate all the various departmental efforts, i.e., planning, budgeting, designing, constructing, operating, and maintaining the various support elements of the comprehensive plan. It is also recommended that the state establish a subordinate law enforcement entity with police powers and arrest authority to adequately control and protect all public and private use and natural resource features of the basin.

F.7.13. A notable amount of trash, litter, and other refuse dumping now occurs in the Lower Atchafalaya Basin Floodway. With implementation of the proposed plan to increase public access and to expand developed public recreational facilities in the floodway, this problem will likely become more serious than exists at present. For this reason, early consideration should be given the problem during formulation of the state management entity. Measures that might be considered for early implementation include: periodic (weekly or more often) cleanup of recreational areas by operations and maintenance personnel; anti-litter public cleanup campaigns; provision of adequate law enforcement surveillance supported by enforceable litter and dumping laws; and the seasonal or rotational closing of certain recreational areas to public use during low visitation periods of the year.

MANAGEMENT, OTHER FEDERAL AGENCIES

F.7.14. The District Engineer will be the sole jurisdictional authority to protect and oversee Federal interests in the Atchafalaya Basin floodway system upon implementation of the comprehensive plan. However, the District Engineer will continue to coordinate with other Federal agencies on collateral interests as required by Federal law and US Army Corps of Engineers' regulations.

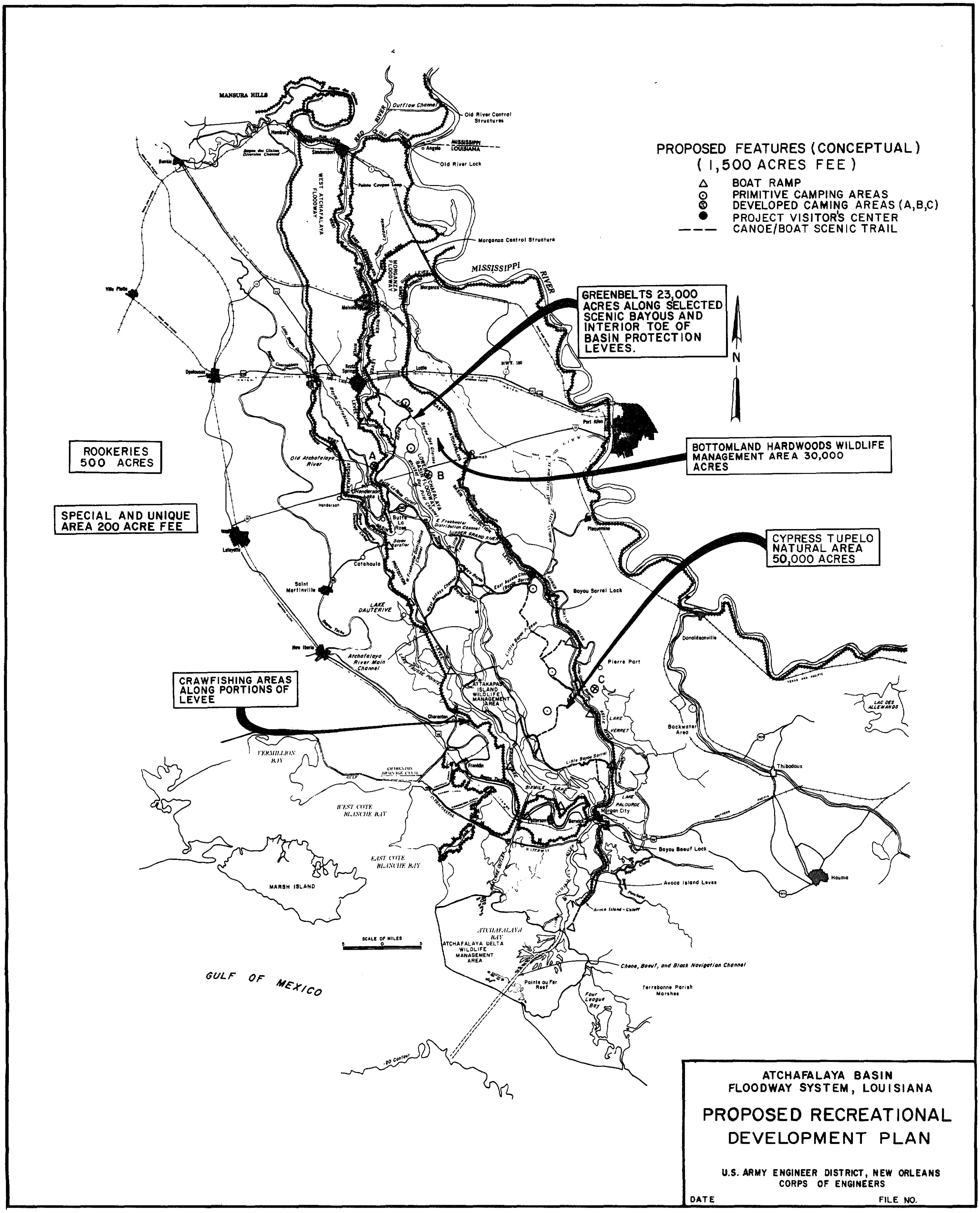
PROPOSED FEATURES (CONCEPTUAL)
(1,500 ACRES FEE)
BOAT RAMP
PRIMITIVE CAMPING AREAS
DEVELOPED CAMING AREAS (A,B,C)
PROJECT VISITOR'S CENTER
CANOE/BOAT SCENIC TRAIL
GREENBELTS 23,000 ACRES ALONG SELECTED SCENIC BAYOUS AND INTERIOR TOE OF BASIN PROTECTION LEVEES.
N
BOTTOMLAND HARDWOODS WILDLIFE MANAGEMENT AREA 30,000 ACRES
CYPRESS TUPELO NATURAL AREA 50,000 ACRES
ROOKERIES 500 ACRES
SPECIAL AND UNIQUE AREA 200 ACRE FEE
CRAWFISHING AREAS ALONG PORTIONS OF LEVEE
MANSURA HILLS
Old River Control Structures
MISSISSIPPI
LOUISIANA
Old River Lock
Morganza Control Structure
MISSISSIPPI RIVER
WEST ATCHAFALAYA FLOODWAY
MORGANZA FLOODWAY
Opelousas
Lafayette
Henderson
Catahoula
Saint Martinville
LAKE DAUTERIVE
New Iberia
Atchafalaya River Main Channel
Charenton
Franklin
Patterson
Berwick
Morgan City
Bayou Sorrel Lock
Pierre Port
Donaldsonville
Thibodaux
Houma
Bayou Boeuf Lock
Avoca Island Levee
LAKE VERRET
LAKE PALOURDE
Backwater Area
LAC DES ALLEMANDS
ATTAKAPAS ISLAND WILDLIFE MANAGEMENT AREA
VERMILLION BAY
WEST COTE BLANCHE BAY
EAST COTE BLANCHE BAY
MARSH ISLAND
ATCHAFALAYA BAY
ATCHAFALAYA DELTA WILDLIFE MANAGEMENT AREA
Chene, Boeuf, and Black Navigation Channel
Terrebonne Parish Marshes
Pointe au Fer Reef
Four League Bay
GULF OF MEXICO
SCALE OF MILES
A
B
C
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
PROPOSED RECREATIONAL
DEVELOPMENT PLAN
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE F-1

APPENDIX G

FISH AND WILDLIFE AND RELATED DATA

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Appendix G

FISH AND WILDLIFE AND RELATED DATA

G.0.1. This report contains a variety of information and data that either supplements data presented in the main report/EIS and other appendixes, or serves to explain how certain data presented in those documents were derived. Included are discussions of fish and wildlife habitat evaluation, mitigation needs, land use projections, desired hydrographs, Section 404 findings and a rationale for determination of marsh deterioration with and without the Avoca Island levee extension. Certain tabular material such as the Audubon Society "blue list," lists of scientific names of plants, and direct construction impacts of levee raising are also included.

Section 1 - AQUATIC HABITAT EVALUATION

G.1.1. The Habitat Evaluation System (HES), a method of evaluating the value of various habitat types for fish and wildlife productivity, has been developed by the US Army Corps of Engineers, Lower Mississippi Valley Division (US Army Corps of Engineers, 1980). This system is used as an aid in planning water resources projects and in determining resulting mitigation needs. The system can be used to estimate the value of lakes, rivers and bayous. However, it does not include a method of evaluating the worth of flooded forest land to the aquatic ecosystem. Since a great deal of hydrologic and land use data exist for the Lower Atchafalaya Basin Floodway (LABF), a method of rating flooded forest lands has been developed by New Orleans District (NOD), Corps of Engineers, and will be described subsequently. Since only limited fishery data exist for the backwater area northeast of Morgan City and since no marsh aquatic HES methodology exists, a decision was made to limit the aquatic HES to the LABF.

Standard Aquatic HES

ACREAGE

G.1.2. For 1980 conditions and all subsequent decades, land use data developed by NOD in January 1981 were utilized. Only acres within the LABF were used. The future without-project condition includes levee raising by local interests. Thus, it was necessary to develop a true future without project that does not include the impacts of levee construction in order to fully evaluate project impacts. According to 33 CFR 230, Appendix A paragraph 6e(4), it is necessary to determine mitigation needs for such non-Federal action included in the future without project condition. To determine the direct construction impacts of levee raising in the LABF, only the floodside borrow pits were considered because landside pits would not be in the LABF.

HES VALUES

G.1.3. Bryan, et al. (1974, 1975, 1976), conducted fishery studies in the Atchafalaya Basin from 1973 to 1976. The data developed in these studies were utilized to prepare the field HES sheets.

G.1.4. Headwater Lakes. Since fish standing crop data have been collected (Sabins 1977), the parameters considered for headwater lakes were reweighted to make total dissolved solids, flooding index, and sport fish standing crop of equal and highest value. Depth, chemical type, turbidity, and total standing crop were of equal but lesser value. Table G-1-1 shows weights of each parameter as well as values from the field sheets. In plans that include clearing for agriculture, turbidity and pesticides would increase dramatically, and it was assumed that the habitat quality index (HQI) would be reduced by 15 percent over 50 years. In plans with no clearing, the HQI was assumed to remain constant over the life of the project.

G.1.5. Backwater Lakes. Bryan, et al. (1974, 1975, 1976), collected little or no data in backwater lakes in the LABF. The one lake studied in the Upper Basin had a HQI value of 0.86, using the reweighted parameters described above. Parameters were made up for a hypothetical LABF backwater lake (Table G-1-2), assuming turbidity was less than that in headwater lakes and that spring flooding was greater than that in an Upper Basin backwater lake. Standing crop values from Lantz (1974) for Henderson Lake were used. It was assumed that plans with clearing would decrease HQI values by 15 percent over 50 years due to increases in pesticides and turbidity. HQI values were assumed to stay constant in plans without clearing.

G.1.6. Cropland Lake. Bryan, et al. (1974, 1975, 1976), had data for three such lakes: two in the Upper Basin and one in the LABF. Since standing crop data for these lakes were available from Sabins (1977), the parameters were reweighted in a manner similar to those for headwater lakes (Table G-1-3). Values from Bryan, et al. (1974, 1975, 1976), were utilized for chemical parameters. Since clearing in the Upper Basin is fairly recent, it was assumed that HQI values for cropland lakes were not as low as possible now. Thus, in plans with clearing the value was assumed to decrease by 5 percent over 50 years, mainly due to the effects of pesticides.

G.1.7. Riverine and Distributary Habitat. Values from Bryan, et al. (1974, 1975, 1976), were utilized. See Table G-1-4 for HQI values. In future projections, a 10-percent loss in HQI values was assumed for plans with clearing. Since this habitat type is highly turbid, the increased turbidity caused by clearing should not have as much impact as in other habitats. The HQI values remained constant in plans with no clearing.

G.1.8. Bayous and Slow-Flowing Canals. Values from Bryan, et al. (1974, 1975, 1976), were used to prepare the field sheets. The waters south of Buffalo Cove (LSU sites WC and WG) were considered to be bayous. See Table G-1-5 for HQI values of various sites. In the future, it was assumed that a 15-percent loss in HQI would occur in plans with clearing. This 15-percent loss would reduce the HQI value to 0.68 by 2030. This compares well to the 0.66 HQI value of upper basin bayous at present. The lower basin bayous should rate slightly higher because they would receive riverine overflow.

TABLE G-1-1

HABITAT EVALUATION SYSTEM FIELD DATA SUMMARY FOR HEADWATER LAKES

PARAMETER	WEIGHT	SAMPLE STATIONS: DUCK LAKE DATA	DUCK LAKE WEIGHTED SCORE	FLAT LAKE DATA	FLAT LAKE WEIGHTED SCORE	LSU WB DATA	LSU WB WEIGHTED SCORE	LSU WD DATA	LSU WD WEIGHTED SCORE	LSU WE DATA	LSU WE WEIGHTED SCORE	LSU WF DATA	LSU WF WEIGHTED SCORE
Total Dissolved Solids (mg/l)	17	191	17	192	17	186	17	203	17	184	17	198	17
Spring Flooding Index	17	120,000	17	100,000	17	144,000	17	72,000	17	72,000	17	108,000	17
Mean Depth (feet)	11	13.0	11	9.5	10.6	7.5	8.3	12.1	11	8.4	9.2	8.5	9.2
Chemical Type	11	$CaMgCO_3$	11	$CaMgCO_3$	11	$CaMgCO_3$	11	$CaMgCO_3$	11	$CaMgCO_3$	11	$CaMgCO_3$	11
Turbidity (JTU)	11	39.0	11	31.0	10.8	63.0	10.9	47.0	11.0	50.0	11	68.0	10.8
Shoreline Development Index	5	1.6	0.6	1.4	0.5	2.0	0.7	2.4	0.9	2.4	0.9	3.1	1.2
Total Fish Standing Crop (lbs/A)	11	414	9.7	414	9.7	414	9.7	414	9.7	414	9.7	414	9.7
Sport Fish Standing Crop (lbs/A)	17	119	17	119	17	119	17	119	17	119	17	119	17
Habitat Quality Index[1/]			0.94		0.94		0.92		0.95		0.93		0.93

[1/] Mean HQI for all stations equalled 0.94 with a standard deviation of 0.01.

TABLE G-1-2

HABITAT EVALUATION SYSTEM FIELD DATA SUMMARY FOR BACKWATER LAKES

		Sample Stations			
		LOWER BASIN HYPOTHETICAL		PETITE PRAIRIE #2	
PARAMETER	WEIGHT	DATA	WEIGHTED SCORE	DATA	WEIGHTED SCORE
Total Dissolved Solids (mg/l)	17	150	17	158	17
Spring Flooding Index	17	30,000	17.0	1,560	11.9
Mean Depth (feet)	11	7.0	7.9	6.0	6.4
Chemical Type	11	$CaMgCO_3$	11	$CaMgCO_3$	11
Turbidity (JTU)	11	17.0	10.5	21.5	10.6
Shoreline Development Index	5	4.0	1.4	4.7	1.7
Total Fish Standing Crop (lbs/A)	11	362	10.6	362	10.6
Sport Fish Standing Crop (lbs/A)	17	134	17	154	17
Habitat Quality Index (HQI)[1/]			0.90		0.86

[1/] Mean HQI for all station equalled 0.88 with a standard deviation of 0.03.

TABLE G-1-3

HABITAT EVALUATION SYSTEM FIELD DATA SUMMARY FOR CROPLAND LAKES

		Sample Stations					
		BIG ALABAMA		PETITE PRAIRIE #4		PETITE PRAIRIE #1	
PARAMETER	WEIGHT	DATA	WEIGHTED SCORE	DATA	WEIGHTED SCORE	DATA	WEIGHTED SCORE
Total Dissolved Solids (mg/l)	17	100	13.6	215	17.0	210	17.0
Spring Flooding Index	17	1,650	11.9	1,560	11.9	1,320	11.2
Mean Depth (feet)	11	13	11.0	8.2	9.0	13	11.0
Chemical Type	11	$CaMgCO_3$	11	$CaMgCO_3$	11	$CaMgCO_3$	11
Turbidity (JTU)	11	25	10.7	25	10.7	17	10.5
Shoreline Development Index	5	2.32	.85	4	1.4	2.9	1.1
Total Fish Standing Crop (lbs/A)	11	495	8.8	495	8.8	495	8.8
Sport Fish Standing Crop (lbs/A)	17	20	6.1	20	6.1	20	6.1
Habitat Quality Index HQI[1/]			0.74		0.76		0.77

[1/] Mean HQI for all stations equalled 0.76 with a standard deviation of 0.02.

TABLE G-1-4

HABITAT EVALUATION SYSTEM FIELD DATA SUMMARY FOR RIVERINE HABITAT

PARAMETER	WEIGHT	Sample Stations LSU RA DATA	LSU RA WEIGHTED SCORE	LSU RB DATA	LSU RB WEIGHTED SCORE
Species Association	30	rough +	9.0	rough +	9.4
Sinuosity Index	20	1.1	5.6	1.1	5.4
Total Dissolved Solids (mg/1)	20	190	20	222	20
Turbidity (JTU)	10	95	6.4	84	7.2
Chemical Type	10	$CaMgCO_3$	10	$CaMgCO_3$	10
Benthic Diversity Index	10	1.8	5	3.6	9.9
Habitat Quality Index (HQI)[1/]			0.56		0.62

[1/] Mean HQI for all stations equalled 0.59 with a standard deviation of 0.04.

TABLE G-1-5

HABITAT EVALUATION SYSTEM FIELD DATA SUMMARY FOR BAYOUS

PARAMETER	WEIGHT	SAMPLE STATIONS									
		LOWER BASIN								UPPER BASIN	
		LSU WG		LSU WG		LSU EB		BIG PIGEON		STATE CANAL	
		DATA	WEIGHTED SCORE	DATA	WEIGHTED SCORE	DATA	WEIGHTED SCORE	DATA	WEIGHTED SCORE	DATA	WEIGHTED SCORE
Species Association	30	LMB/BC[2/]	24	LMB/BC	24	LMB/BC	24	LMB/BC	24	BC/WAR[3/]	12
Sinuousity Index[1/]	20	1.2	10	1.2	10	1.2	10	1.2	10	1.2	10
Total Dissolved Solids (mg/1)	20	182	20	190	20	214	20	256	20	177	20
Turbidity (JTU)	10	66	8.4	68	8.3	48	9.3	64	8.4	33	9.8
Chemical Type	10	$CaMgCO_3$	10	$CaMgCO_3$	10	$CaMgCO_3$	10	$CaMgCO_3$	10	$CaMgCO_3$	10
Benthic Diversity Index	10	1.8	5	1.8	5	4.4	10	3.1	9	1.6	4.2
Habitat Quality Index (HQI)[4/]			0.77		0.77		0.83		0.81		0.66

1/Sinuosity was exceedingly low at two LSU sites and exceptionally high at a third. Average sinuosity was measured at random for several bayous; it was 1.2.

2/Largemouth bass, bluegill, crappie

3/Bluegill, crappie, warmouth

4/Mean HQI for all stations equalled 0.77 with a standard deviation of 0.07.

Aquatic HES for Flooded Forest

G.1.9. Since much of the aquatic productivity in the LABF depends on seasonally flooded woodlands, it was necessary to evaluate the quality of such habitat and to project changes over the project life.

ACREAGE

G.1.10. The peak of the average shifted stage hydrograph (ASSH) was noted for each management unit (see Appendix C). The number of acres of each forest type flooded at the peak of the hydrograph was determined from 1980 stage area curves. To estimate 2030 conditions, the acres of each habitat type below the projected flood-free 3 years out of 5 elevation were determined from the appropriate stage area curves. Then since about 80 percent of the acres above the flood-free 3 out of 5 elevation were estimated to be cleared in the NED plan, 20 percent of the acres between the flood-free peak and the ASSH peak were assumed to be flooded forest. This 20 percent was added to the acres below the flood-free peak to get the total flooded forest in 2030 for the NED plan. In the EQ and tentatively selected plans, the entire acreage below the 2030 ASSH peak was determined to be flooded. In the management units that are proposed for implementation, the peak of the achievable hydrograph was used (see Appendix C). Once the number of flooded forest acres was known for 1980 and 2030, the percent this was of the whole forest acreage for these years was calculated. Then since the hydrograph peaks drop in a linear fashion, it was possible to extrapolate the percentage of flooded forest for each habitat type by decade. These percentages were then applied to the total acreage for each habitat type. To estimate direct construction impacts in flooded forest, the impacts of levee raising for the West Atchafalaya Basin Protection Levee (WABPL) were subtracted from flooded early and late successional forests in 1990 and all subsequent years. Much of the bottomland hardwood forest adjacent to the East Atchafalaya Basin Protection Levee (EABPL) is at a high elevation and is not flooded on the ASSH. In cypress-tupleo, impacts of levee raising from both the WABPL and EABPL were subtracted from 1990 and subsequent years. Since the HES base must not consider any levee raising prior to 1980, all impacts are subtracted from 1990 so that mitigation could be accomplished.

HES VALUES

G.1.11. It was decided that the most important parameter in determining the value of flooded forests to the aquatic ecosystem was the duration of flooding. Crawfish use the flooded forests in March and April, and buffalo spawn there. Shad, crappie, and gar are spring spawners, and their young utilize the flooded forests for nursery areas. A second factor that makes flooded forests valuable to the aquatic ecosystem is the production of ground cover and understory. Conner and Day (1976) showed that understory and ground cover were responsible for 40 percent of the non-tree biomass in wet bottomland hardwoods. These wet bottomland hardwoods produce the maximum amount of herbaceous ground cover if water is off them by the end of May or early June.

G.1.12. The average shifted stage hydrographs were utilized to determine the stages at which the various management units were flooded for varying lengths of time. Table G-1-6 shows the weights allocated to each period of flooding by habitat type and the time by which the water would be off the woods for each period. The basic rationale behind the weighting for late successional bottomland hardwoods was that optimal conditions would be to have no flooding later than 1 June. Flooding over 5.5 months was considered to be of little value to the aquatic system, since very little ground cover would be produced in such cases. Since early successional bottomland hardwoods generally have less herbaceous ground cover than late successional forests, they were weighted less than late successional and the optimal flooding period was again 2.5 to 3.5 months. The main contribution of cypress-tupelo is as aquatic habitat; therefore, the optimal flooding period was considered to be 5.5 to 6.5 months. Flooding would occur on some areas after 1 August, but dissolved oxygen conditions would be very poor; therefore, no value was assigned to these periods.

TABLE G-1-6

WEIGHTS APPLIED TO VARIOUS PERIODS OF FLOODING

Period of Flooding (Months)	Weights			Average Date Water is Removed from woods
	Late Successional Bottomland Hardwood	Early Successional Bottomland Hardwood	Cypress Tupelo	
1.5-2.5	0.8	0.6	0.3	12 May
2.5-3.5	1.0	0.8	0.6	26 May
3.5-4.5	0.7	0.7	0.7	11 June
4.5-5.5	0.5	0.5	0.8	01 July
5.5-6.5	0	0	1	07 July
6.5-7.5	0	0	0.9	15 July
7.5-8.5	0	0	0.3	25 July

G.1.13. These weights are basically individual HQI values for each habitat type for specific periods of flooding. To determine the general HQI for a habitat type, the number of acres flooded for each specific period in each management unit were multiplied by the weight for that period to get the total weighted acres per management unit. This acreage was summed by habitat type and then divided by the total wet acreage of each habitat type so that the HQI value of an individual acre could be determined. The HQI values of each habitat type are shown in Tables G-1-7 to G-1-10.

Habitat Evaluation Analysis

G.1.14. For each plan, the acreage and HQI value for each habitat type by 10-year increments was compared to the similar value for future without project conditions (Tables G-1-7 to G-1-10). Similar habitat types were combined in order to simplify the mitigation calculations. Thus, riverine habitat and bayous; all lake types; and all flooded forests were combined. Table G-1-11 indicates the annualized habitat units lost or gained by combined habitat types.

TABLE G-1-7

AQUATIC HABITAT EVALUATION SYSTEM
Acres (thousands) and Habitat Quality Index (HQI) by Years
FWO

Habitat Type		1980 Base Condition	1990 Without Project	1990 With Project	2000 Without Project	2000 With Project	2010 Without Project	2010 With Project	2020 Without Project	2020 With Project	2030 Without Project	2030 With Project
River and distributary	(Acres)	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0
	(HQI)	.59	.578	.578	.566	.566	.554	.554	.543	.543	.531	.531
Bayous and slow-flowing canals [1/]	(Acres)	9.8	9.8	15.1	9.8	15.1	9.8	15.1	9.8	15.1	9.8	15.1
	(HQI)	.80	.776	.776	.752	.752	.728	.728	.704	.704	.68	.68
Headwater lakes	(Acres)	17.7	14.4	14.4	11.2	11.2	7.8	7.8	4.6	4.6	1.3	1.3
	(HQI)	.935	.907	.907	.879	.879	.851	.851	.823	.823	.795	.795
Backwater lakes	(Acres)	13.8	12.7	21.7	10.6	10.6	7.8	7.8	6.8	6.8	5.9	5.9
	(HQI)	.90	.873	.873	.846	.846	.819	.819	.792	.792	.765	.765
Cropland lakes	(Acres)	0.03	0.3	0.3	1.6	1.6	3.7	3.7	3.9	3.9	4.1	4.1
	(HQI)	.76	.752	.752	.745	.745	.737	.737	.730	.730	.722	.722
Late Successional Bottomland hardwoods flooded by ASSH [2/]	(Acres)	128.0	139.5	136.4	116.1	113.0	83.0	79.9	74.3	71.1	69.9	66.8
	(HQI)	.27	.265	.265	.259	.259	.254	.254	.248	.248	.243	.243
Early Successional Bottomland hardwoods flooded by ASSH [3/]	(Acres)	73.3	52.9	50.3	50.9	46.7	45.6	40.0	41.3	33.9	30.0	29.1
	(HQI)	.27	.265	.265	.259	.259	.254	.254	.248	.248	.243	.243
Cypress-tupelo [4/] flooded by ASSH	Acres)	173.0	167.9	163.6	166.1	163.8	158.4	156.0	152.6	150.2	148.3	145.9
	(HQI)	.55	.539	.539	.528	.528	.517	.517	.506	.506	.495	.495

1/Direct construction impacts of floodside levee raising were added to bayous and subtracted from forested wetlands for 1990 and carried through 2030.
2/Average shifted stage hydrograph.
3/Includes composition unknown acres.
4/Includes bottomland hardwood mixed with cypress-tupelo.

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TABLE G-1-8

AQUATIC HABITAT EVALUATION SYSTEM
Acres (thousands) and Habitat Quality Index (HQI) by Years
EQ Plan

Habitat Type		1980 Base Condition	1990 Without Project	1990 With Project	2000 Without Project	2000 With Project	2010 Without Project	2010 With Project	2020 Without Project	2020 With Project	2030 Without Project	2030 With Project
River and distributary	(Acres)	23.0	23.0	23.0	23.0	23.9	23.0	23.9	23.0	23.9	23.0	23.9
	(HQI)	.59	.578	.59	.566	.59	.554	.59	.543	.59	.531	.59
Bayous and slow-flowing canals[1/]	(Acres)	9.8	9.8	13.9	9.8	13.9	9.8	13.9	9.8	13.9	9.8	13.9
	(HQI)	.80	.776	.80	.752	.80	.728	.80	.704	.808	.68	.80
Headwater lakes	(Acres)	17.7	14.4	14.7	11.2	11.7	7.8	8.6	4.6	5.5	1.3	2.6
	(HQI)	.935	.907	.935	.879	.935	.851	.935	.823	.935	.795	.935
Backwater lakes	(Acres)	13.8	12.7	13.0	10.6	12.3	7.8	11.6	6.8	10.8	5.9	10.1
	(HQI)	.90	.873	.90	.846	.90	.819	.90	.792	.90	.765	.90
Cropland lakes	(Acres)	0.03	0.3	0.03	1.6	0.03	3.7	0.03	3.9	0.03	4.1	0.03
	(HQI)	.76	.752	.76	.745	.76	.737	.76	.730	.76	.722	.76
Late Successional Bottomland hardwoods flooded by ASSH [2/]	(Acres)	128.0	139.5	126.0	116.1	113.3	83.0	100.0	74.3	87.8	69.9	75.0
	(HQI)	.27	.265	.27	.259	.27	.254	.27	.248	.27	.243	.27
Early Successional Bottomland hardwoods flooded by ASSH [3/]	(Acres)	73.3	52.9	51.8	50.9	51.6	45.6	47.9	41.3	44.6	30.0	40.3
	(HQI)	.27	.265	.27	.259	.27	.254	.27	.248	.27	.243	.27
Cypress-tupelo [4/] flooded by ASSH	Acres)	173.0	167.9	164.0	166.1	157.3	158.4	150.8	152.6	144.3	148.3	138.0
	(HQI)	.55	.539	.55	.528	.55	.517	.55	.506	.55	.495	.55

[1/] Direct construction impacts of floodside levee raising were added to bayous and subtracted from forested wetlands for 1990 and carried through 2030.
[2/] Average shifted stage hydrograph.
[3/] Includes composition unknown acres.
[4/] Includes bottomland hardwood mixed with cypress-tupelo.

G-14

TABLE G-1-9

AQUATIC HABITAT EVALUATION SYSTEM
Acres (thousands) and Habitat Quality (HQI) by Years
NED Plan

Habitat Type		1980 Base Condition	1990 Without Project	1990 With Project	2000 Without Project	2000 With Project	2010 Without Project	2010 With Project	2020 Without Project	2020 With Project	2030 Without Project	2030 With Project
River and distributary	(Acres)	23.0	23.0	23.5	23.0	23.5	23.0	23.5	23.0	23.5	23.0	23.5
	(HQI)	.59	.578	.578	.566	.566	.554	.554	.543	.543	.531	.531
Bayous and slow-flowing canals 1/	(Acres)	9.8	9.8	13.6	9.8	13.6	9.8	13.6	9.8	13.6	9.8	13.6
	(HQI)	.80	.776	.776	.752	.752	.728	.728	.704	.704	.68	.68
Headwater lakes	(Acres)	17.7	14.4	14.4	11.2	11.2	7.8	7.8	4.6	4.5	1.3	1.3
	(HQI)	.935	.907	.907	.879	.879	.851	.851	.823	.823	.795	.765
Backwater lakes	(Acres)	13.8	12.7	1.27	10.6	10.2	7.8	7.8	6.8	6.3	5.9	5.2
	(HQI)	.90	.873	.873	.846	.846	.819	.819	.792	.792	.765	.765
Cropland lakes	(Acres)	0.03	0.3	0.4	1.6	2.0	3.7	3.8	3.9	4.6	4.1	4.9
	(HQI)	.76	.752	.752	.745	.745	.737	.737	.730	.730	.722	.722
Late Successional Bottomland hardwoods flooded by ASSH 2/	(Acres)	128.0	139.5	134.3	116.1	108.6	83.0	76.7	74.3	59.7	69.9	57.3
	(HQI)	.27	.265	.265	.259	.259	.254	.254	.248	.248	.243	.243
Early Successional Bottomland hardwoods flooded by ASSH 3/	(Acres)	73.3	52.9	51.8	50.9	49.5	45.6	43.1	41.3	37.8	37.0	33.3
	(HQI)	.27	.265	.265	.259	.259	.254	.254	.248	.248	.243	.243
Cypress-tupelo 4/ flooded by ASSH	Acres)	173.0	167.9	162.3	166.1	151.6	158.4	137.3	152.6	125.8	148.3	116.0
	(HQI)	.55	.539	.539	.528	.528	.517	.517	.506	.506	.495	.495

1/Direct construction impacts of floodside levee raising were added to bayous and subtracted from forested wetlands for 1990 and carried through 2030.
2/Average shifted stage hydrograph.
3/Includes composition unknown acres.
4/Includes bottomland hardwood mixed with cypress-tupelo.

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TABLE G-1-10

AQUATIC HABITAT EVALUATION SYSTEM
Acres (thousands) and Habitat Quality Index (HQI) by Years
Recommended Plan

Habitat Type		1980 Base Condition	1990 Without Project	1990 With Project	2000 Without Project	2000 With Project	2010 Without Project	2010 With Project	2020 Without Project	2020 With Project	2030 Without Project	2030 With Project
River and distributary	(Acres)	23.0	23.0	23.8	23.0	23.0	23.0	23.8	23.0	23.8	23.0	23.8
	(HQI)	.59	.578	.59	.566	.566	.554	.59	.543	.59	.531	.59
Bayous and slow-flowing canals 1/	(Acres)	9.8	9.8	13.7	9.8	13.7	9.8	13.7	9.8	13.7	9.8	13.7
	(HQI)	.80	.776	.80	.752	.80	.728	.80	.704	.80	.68	.80
Headwater lakes	(Acres)	17.7	14.4	14.7	11.2	11.7	7.8	9.6	4.6	5.5	1.3	2.5
	(HQI)	.935	.907	.935	.879	.935	.851	.935	.823	.935	.795	.935
Backwater lakes	(Acres)	13.8	12.7	13.0	10.6	12.3	7.8	11.6	6.8	10.8	5.9	10.1
	(HQI)	.90	.873	.90	.846	.90	.819	.90	.792	.90	.765	.90
Cropland lakes	(Acres)	0.03	0.3	0.03	1.6	0.03	3.7	0.03	3.9	0.03	4.1	0.03
	(HQI)	.76	.752	.76	.745	.76	.737	.76	.730	.76	.722	.76
Late Successional Bottomland hardwoods flooded by ASSH 2/	(Acres)	128.0	139.6	126.1	116.1	113.4	83.0	100.6	74.3	88.0	70.0	75.2
	(HQI)	.27	.265	.27	.259	.27	.254	.27	.248	.27	.243	.27
Early Successional Bottomland hardwoods flooded by ASSH 3/	(Acres)	73.3	52.9	52.5	50.9	41.9	45.6	50.4	41.3	48.2	37.0	45.1
	(HQI)	.27	.265	.27	.259	.27	.254	.27	.248	.27	.243	.27
Cypress-tupelo 4/ flooded by ASSH	Acres)	173.0	167.9	163.9	166.1	157.2	158.4	150.7	152.6	144.2	148.3	137.9
	(HQI)	.55	.539	.55	.528	.55	.517	.55	.506	.55	.495	.55

1/ Direct construction impacts of floodside levee raising were added to bayous and subtracted from forested wetlands for 1990 and carried through 2030.
2/ Average shifted stage hydrograph.
3/ Includes composition unknown acres.
4/ Includes bottomland hardwood mixed with cypress-tupelo.

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TABLE G-1-11

ANNUALIZED HABITAT UNITS LOST OR GAINED[1/]

Habitat Type	Plan 2 FWO	Plan 4 EQ	Plan 7 NED	Plan 9 TSP
Riverine and bayou	+3,509	+4,684	+2,770	+4,470
Lakes	0	+1,714	+32	+2,017
Flooded forest	-3,016	+7,192	-8,470	+7,176

1/ Figures for flooded forest are adjusted to show the contribution due to the widening of the Wax Lake overbank area which was not calculated in the initial computations made using the data in tables G-1-7 through G-1-10.

Section 2 - TERRESTRIAL WILDLIFE HABITAT EVALUATION FIELD METHODOLOGY

G.2.1. Two habitat evaluation techniques were used to evaluate possible impacts of the future without-project condition and the three final plans and to calculate mitigation needs.

G.2.2. Evaluation of most terrestrial habitats was carried out using a slightly modified version of the HES methods developed by the US Army Corps of Engineers, Lower Mississippi Valley Division (US Army Corps of Engineers 1980). A total of 37 terrestrial sites were studied within the project affected areas of the Lower Atchafalaya Basin floodway and the backwater area northeast of Morgan City (Figure G-2-1).

G.2.3. Marsh habitats were evaluated using an experimental technique, being developed by the US Army Corps of Engineers, New Orleans District, which is similar to the HES. This method, which will be referred to as the Marsh Evaluation Technique (MET), was applied to 21 sites located within the marshlands to the south of Morgan City (Figure G-2-1).

G.2.4. Both of these methods are based upon the assumption that the presence or absence, and the abundance and diversity of animal populations in a habitat are determined by basic biotic and abiotic factors that can be readily quantified (US Army Corps of Engineers 1980). By varying these factors, the value of the habitat for fish or wildlife is rated on a scale from 0 to 1.

Habitat Evaluation System HES

G.2.5. Evaluation of 44 terrestrial plots located within the Lower Atchafalaya Basin Floodway and the backwater area northeast of Morgan City was carried out during the summer and fall of 1980 and the early winter of 1981. These 44 plots were located within 37 study sites which were generally randomly located within the major habitat types of the area, although time and access problems made it necessary to

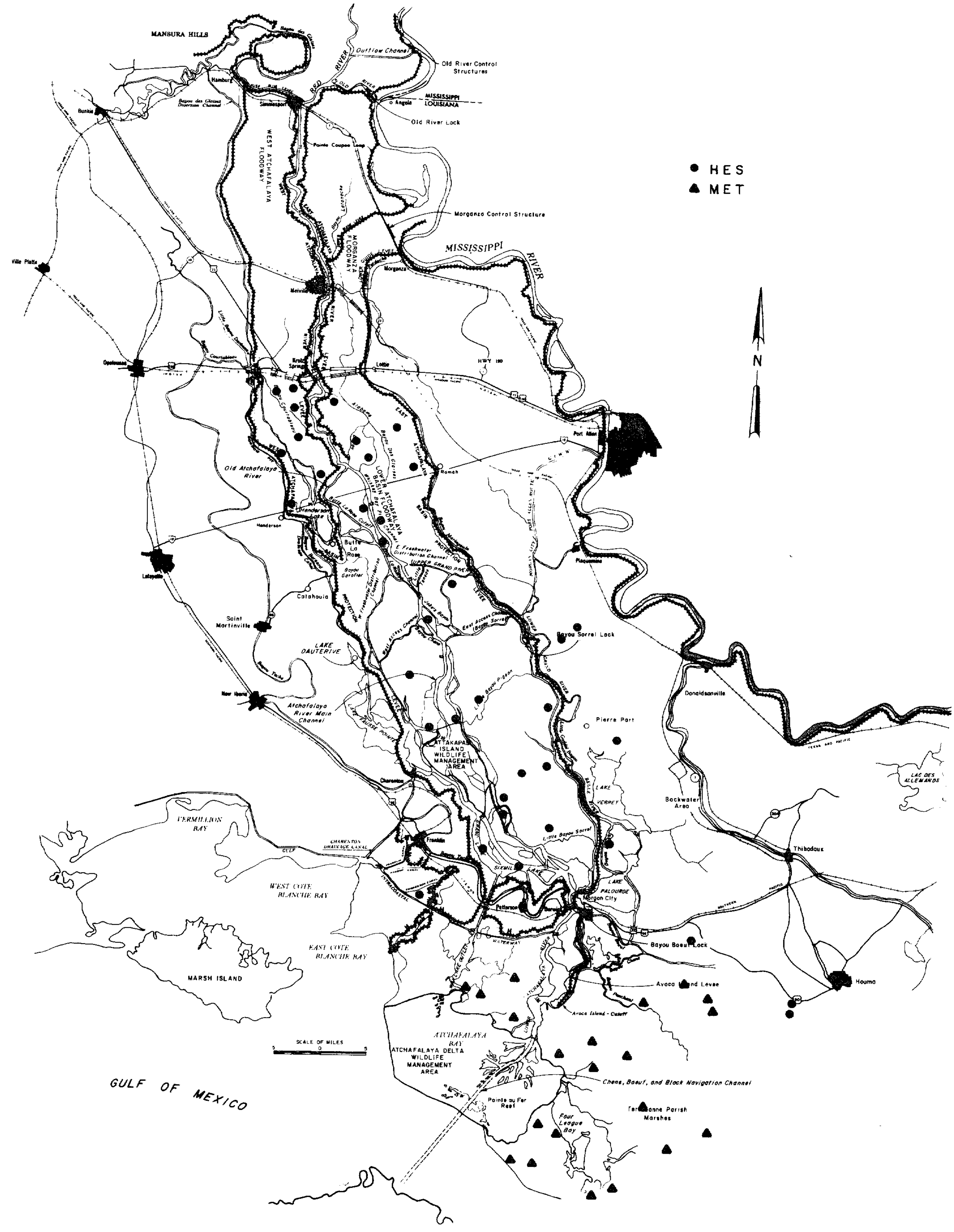


FIGURE G-2-1 HABITAT EVALUATION STUDY SITES locate several sites adjacent to existing roads. Plot sizes were as prescribed in the standard HES methodology (US Army Corps of Engineers 1980). Results of the habitat evaluation analyses made on these plots are presented in Table G-2-1.

Marsh Evaluation Technique MET

G.2.6. Evaluation of 21 marsh plots located within the marsh areas south of Morgan City was carried out during the summer of 1980. These 21 plots were randomly located along major bayous and canals within fresh, brackish, and saline marsh types. Each plot consisted of a circular area with a radius of 1 kilometer. Within each plot, a habitat quality index was calculated in a manner similar to that used for determination of the HES habitat quality index. Five parameters were measured and used to calculate the habitat quality index. Each of these will be briefly described.

PLANT DIVERSITY

G.2.7. Plant diversity was measured by walking two randomly located 150 meter transects which were perpendicular to bayous or canals within each circular plot. A list of all plants seen along each transect was made and the total number of different species seen along both transects was determined. This number was then used in conjunction with a functional curve (Figure G-2-2) to calculate a curve score which is thought to be indicative of the value of the habitat for wildlife. The functional curve was drawn based upon the knowledge that wildlife value of marsh areas appears to be correlated with plant diversity. A survey of available literature and personal experience of a number of biologists was used as a basis for shaping the curve. Once the curve score was calculated, it was entered upon a data sheet (Figure G-2-3) and was later used in calculating a habitat quality index.

PERCENTAGE OF OPEN WATER

G.2.8. Percentage of open water making up the plot was determined using high-altitude color infrared photographs of the area made in 1978. Once the percentage figure was known, it was used in conjunction with a set of functional curves (Figure G-2-4) to determine a curve score which was entered upon the previously mentioned data sheet. Percentage of open water was assumed to be a good indicator of the amount of intertidal area or water-marsh "edge" within the plot;

TABLE G-2-1

HABITAT EVALUATION SYSTEM -
HABITAT QUALITY INDEX VALUES FOR TERRESTRIAL WILDLIFE

Habitat Type	Plot No.	HQI Value[1/][4/]
LSBLHW[2/]	1	0.62
	2	0.56
	3	0.62
	4	0.51
	5	0.78
	6	0.44
	7	0.43
	8	0.60
	9	0.49
	10	0.63
	11	0.77
	12	0.58
	13	0.52
	14	0.43
	15	0.57
	16	0.64
	17	0.66
	18	0.50
ESBLHW[3/]	1	0.41
	2	0.44
	3	0.58
	4	0.32
	5	0.32
	6	0.46
	7	0.54
	8	0.39
Cypress-tupelo	1	0.71
	2	0.68
	3	0.71
	4	0.60
	5	0.73
	6	0.51
	7	0.55
	8	0.73
	9	0.75
	10	0.71
	11	0.71
	12	0.65
Open Land	1	0.33
	2	0.14
	3	0.42
	4	0.12
	5	0.15
	6	0.36

[1/]Habitat Quality Index - Possible values range from 0, which indicates habitat of no value, to 1, indicating habitat of maximum value.

[2/]Late successional bottomland hardwood forest.

[3/]Early successional bottomland hardwood forest.

[4/]Mean HQI and standard deviation for each habitat type are as follows: LSBLHW: 0.58 (0.10), ESBLHW: 0.43 (.09), Cypress-tupelo: 0.67 (0.77), and Open land: 0.26 (0.13).

FIGURE G-2-2
Marsh - Diversity of Emergent & Submergent Plant

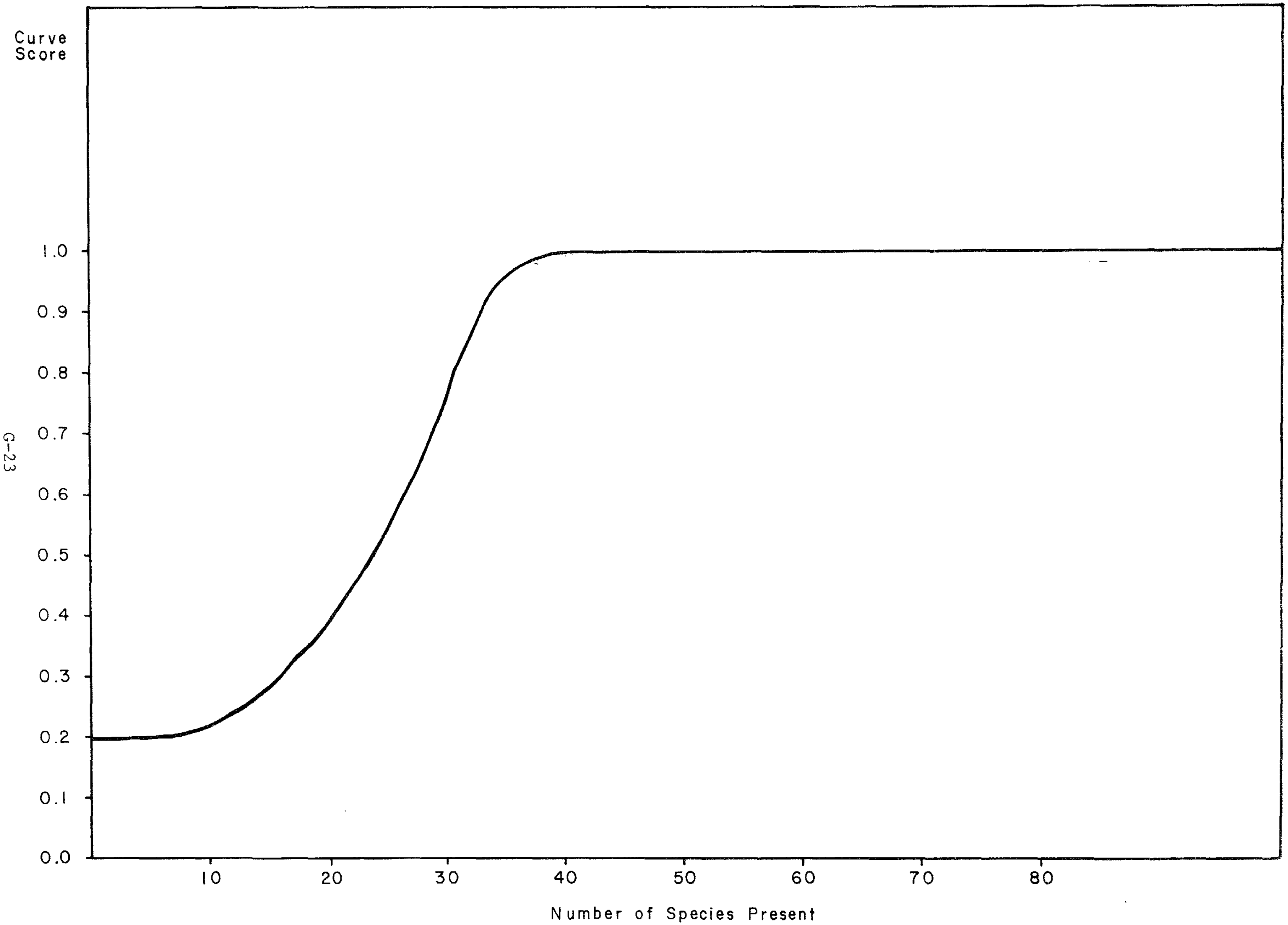


FIGURE G-2-3
MET EVALUATION

Site No.: Date:

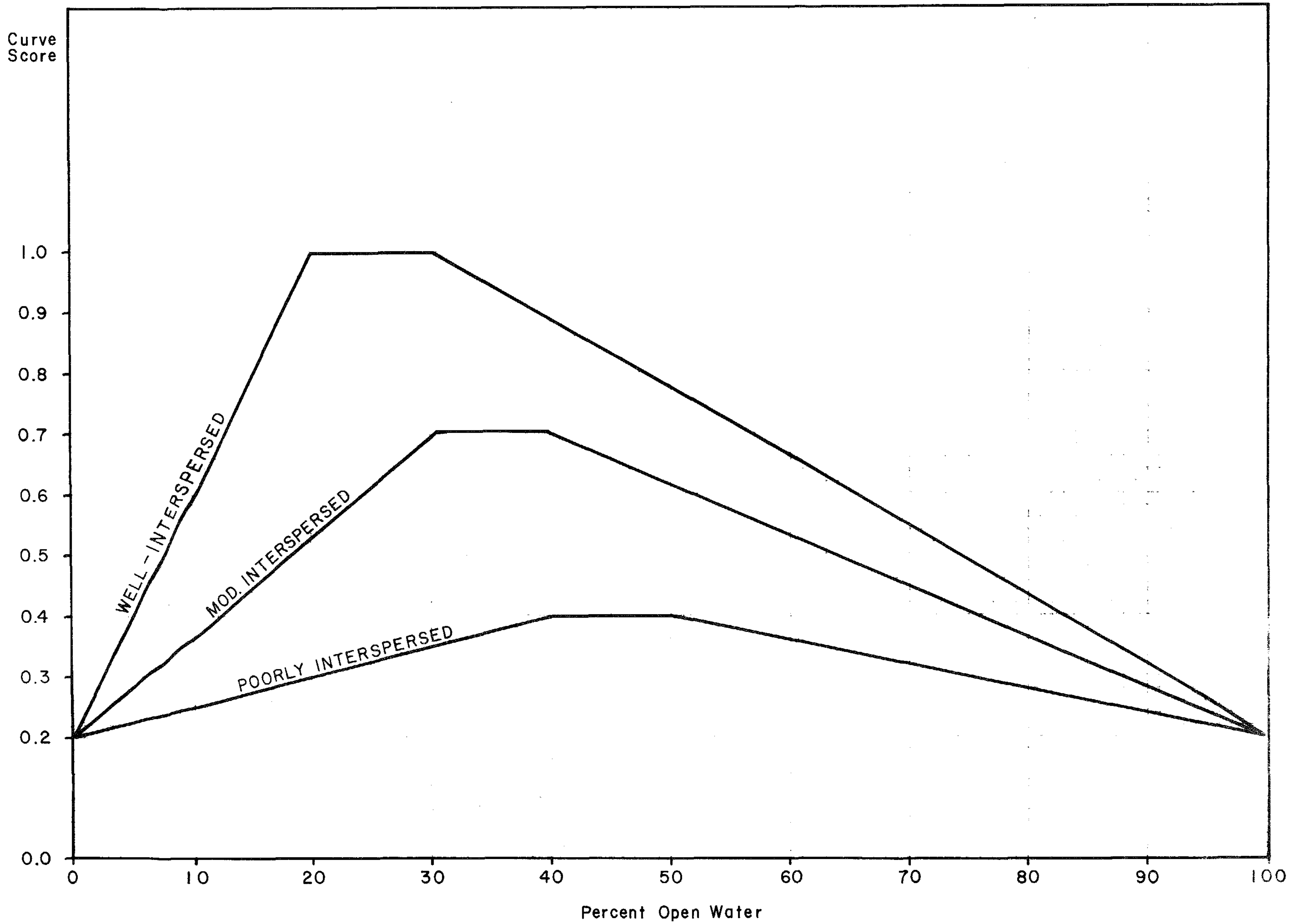
Location:

Habitat Type: Marsh HQI Score:

Parameter	Data	Curve Score	Curve Wt.	Weighted Score
1. Plant Diversity			0.30	
2. % Open Water			0.20	
3. % Non-flooded			0.20	
4. No. Ponds/3.14 km^2			0.10	
5. Naturalness Index			0.20	
	TOTAL			

NOTES

FIGURE G-2-4
Marsh - Percent Open Water



and accordingly, three functional curves were drawn to reflect how well the open water was interspersed with marsh vegetation. The three curves were drawn based primarily upon the personal experience of several biologists.

PERCENTAGE NON-FLOODED LAND

G.2.9. Percentage of land not flooded by a normal high tide was determined by using color infrared photos as described above, which were "ground truthed" at the same time the plant diversity transects were made. (Such lands are important for species such as rabbits and for shrub or tree nesting birds.) These percentage figures were used with a set of functional curves (Figure G-2-5) based upon the personal knowledge of several biologists to obtain curve scores which were then entered upon data sheets.

NUMBER OF PONDS

G.2.10. The number of ponds from 1 to 10 acres in size within each plot was calculated using the previously described color infrared photos. [Ponds of this size contain the greatest numbers of species of aquatic plants (Chabreck 1972) and are heavily utilized by waterfowl.] The number of ponds was used with a set of functional curves (Figure G-2-6) based upon the personal experience of several biologists, to calculate a curve score which was then entered upon a data sheet.

NATURALNESS INDEX

G.2.11. A naturalness curve score was calculated and entered upon a data sheet using the functional curve shown in Figure G-2-7. Naturalness was determined subjectively by use of color infrared photos as well as on-site inspection. Presence of man-made canals, levees or other structures, and presence or absence of pollutants were primary factors used in determining naturalness.

CALCULATION OF HABITAT QUALITY INDEX

G.2.12. A habitat quality index was calculated for each marsh plot using the five curve scores entered upon the data sheets (Figure G-2-3). Each parameter was assigned a weight. Weighted curve scores were then calculated and summed to obtain a habitat quality index for each plot. Results of these determinations are shown in Table G-2-2.

FIGURE G-2-5
Marsh - Percent Non Flooded Land

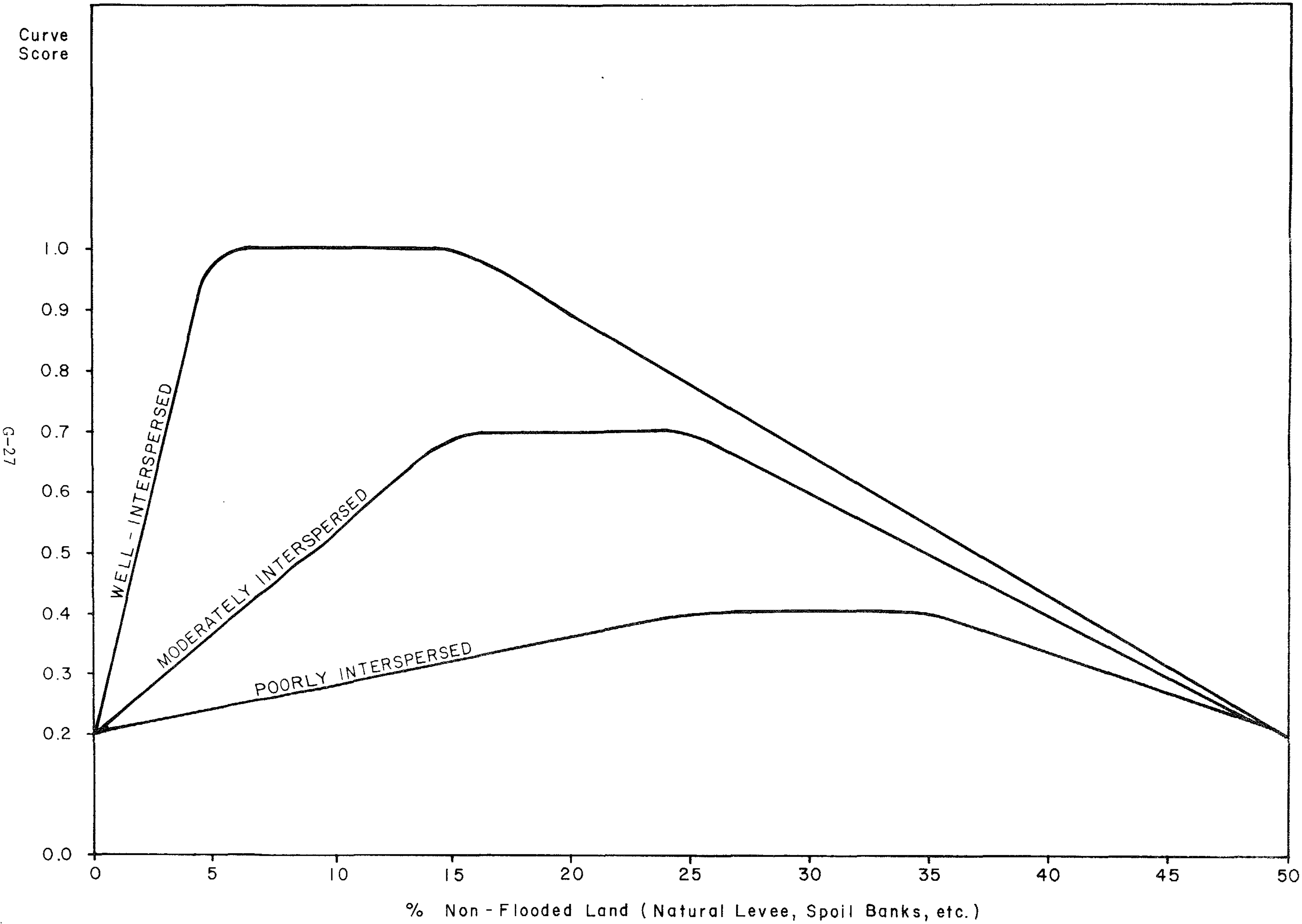


FIGURE G-2-6
Marsh - Number of Ponds 1-10 A in Size / 3.14 Km^2

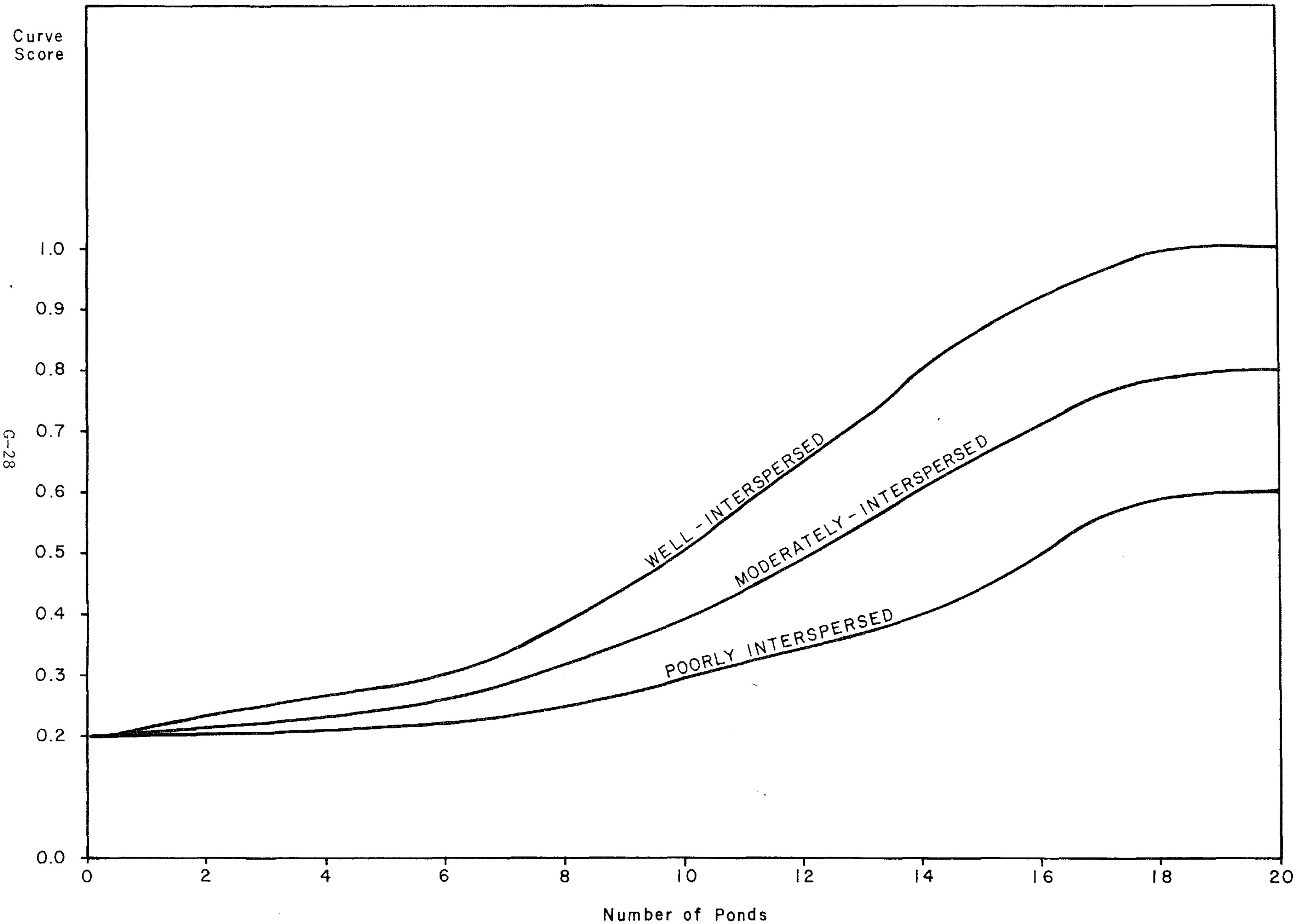


FIGURE G-2-7
Marsh - Naturalness Index

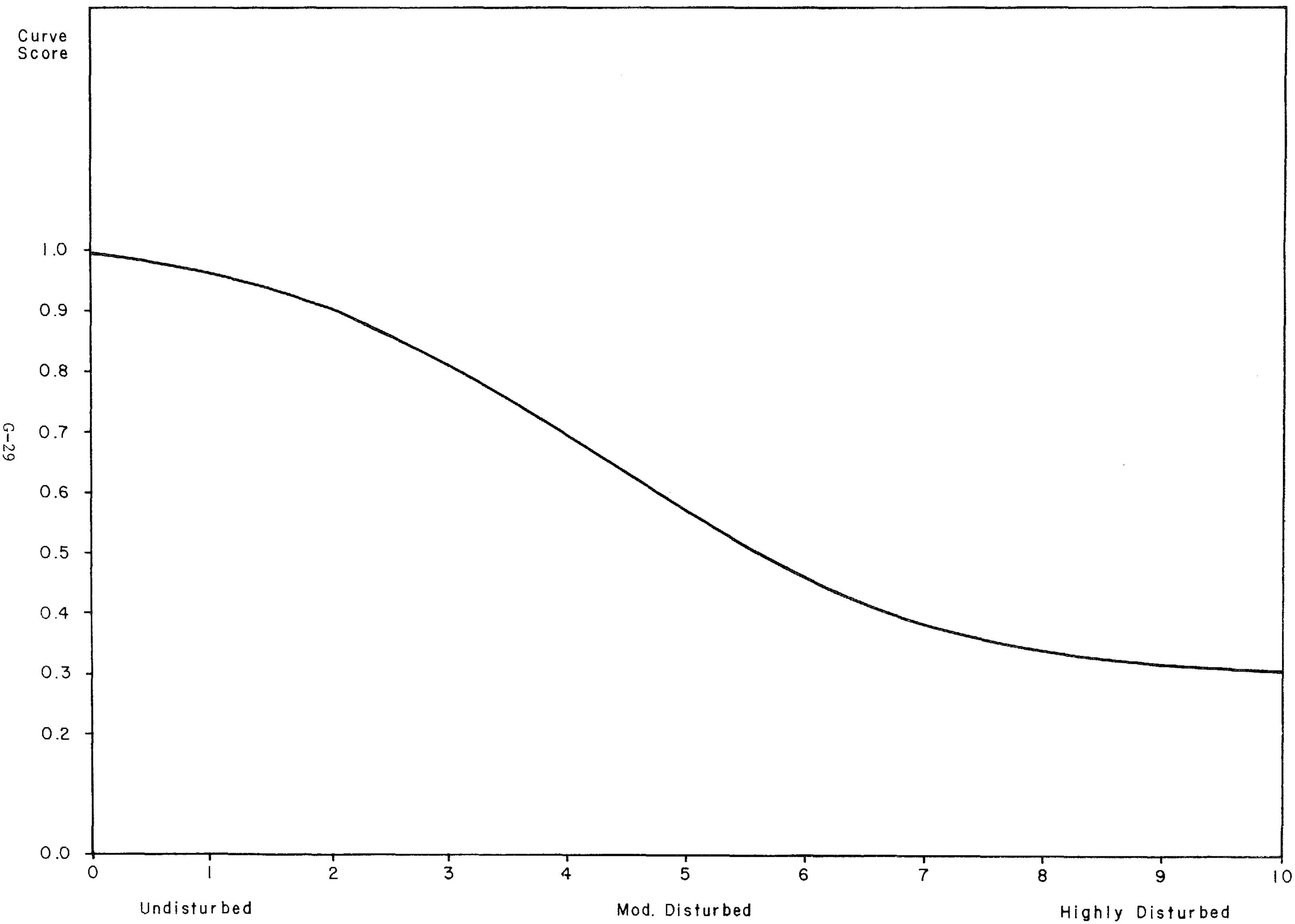


TABLE G-2-2

MARSH EVALUATION TECHNIQUE -
HABITAT QUALITY INDEX VALUES FOR TERRESTRIAL WILDLIFE

Habitat Type	Plot No.	HQI Value[1/][2/]
Fresh Marsh	8	0.57
	5	0.61
	14	0.66
	17	0.78
	12	0.62
	1	0.76
	6	0.51
	5	0.48
	2	0.82
	9	0.76
	11	0.73
	4	0.70
Brackish Marsh	8	0.70
	9	0.84
	4	0.60
	6	0.58
	13	0.51
	15	0.70
	11	0.48
Saline Marsh	4	0.49
	3	0.58

1/Habitat Quality Index - Possible values range from 0, which indicates habitat of no value, to 1, indicating habitat of maximum value.

2/Mean HQI and standard deviations for each marsh type are as follows: Fresh marsh: 0.67 (0.10), Brackish marsh: 0.63 (0.13), Saline marsh: 0.54 (0.06).

Section 3 - TERRESTRIAL WILDLIFE HABITAT EVALUATION ANALYSIS

G.3.1. Habitat gains or losses in habitat units for the future without-project condition and the final three plans were calculated using the habitat evaluation field data previously described as a base. The existing habitat quality indices (HQI) for each habitat type were projected 50 years into the future. Tables G-3-1, G-3-2, and G-3-3 show the existing and projected values which were used in mitigation analyses and the rationale used in formulating them. Management potential and preservation credit for proposed bottomland hardwood fee purchase mitigation lands were calculated as follows.

Management Potential

G.3.2. It was assumed that the management potential for any bottomland hardwood fee lands obtained within the Lower Atchafalaya Basin floodway would be directly proportioned to the increase in HQI that would result from removal of cattle from the area. Existing HQI values for grazed and ungrazed lands near the Old River control structure were used as a basis for making the necessary calculations as outlined in the standard HES methodology (US Army Corps of Engineers 1980). Since management potential equals the annualized HQI of lands to be purchased with management minus the annualized HQI of proposed mitigation lands without management, this value was calculated as follows:

$$\underbrace{\frac{0.575^{1/} + 0.744^{2/}}{2}}_{\text{Land with management}} \quad \text{minus} \quad \underbrace{\frac{0.575^{1/} + 0.604^{3/}}{2}}_{\text{Land without management}} = 0.07$$

1/ 1980 HQI of grazed lands in floodway

2/ 1980 HQI of ungrazed lands at Old River (this was assumed to be the 2030 HQI of floodway lands)

3/ 1980 HQI of grazed lands at Old River (this was assumed to be the 2030 HQI of floodway lands)

TABLE G-3-1
ACTUAL AND PROJECTED HABITAT QUALITY INDICES
FOR THE FUTURE WITHOUT PROJECT CONDITION

Habitat Type	Year 1980	1990	2000	2010	2020	2030
Late Successional Bottomland Hardwood Forest	0.575	0.581	0.587	0.593	0.599	0.605 1/
Early Successional Bottomland Hardwood and Composition Unknown Forest	0.432	0.446	0.460	0.474	0.488	0.504 2/
Cypress-Tupelo and Bottomland Hardwood/Cypress-Tupelo Mixed Forest	0.670	0.670	0.670	0.670	0.670	0.670 3/
Open Land	0.256	0.245	0.234	0.223	0.212	0.200 4/
Fresh Marsh and Delta	0.668	0.655	0.642	0.629	0.616	0.601 5/
Brackish Marsh	0.630	0.617	0.604	0.591	0.578	0.567 5/
Saline Marsh	0.535	0.524	0.513	0.502	0.491	0.481 5/

1/ 0.605 equals the present Habitat Quality Index (HQI) of grazed late successional bottomland hardwood forest at Old River.

2/ 0.504 equals the mid-point between 1980 HQI values for early and late successional bottomland hardwood forest.

3/ Assumed to stay the same due to the cancelling effect of logging timber and increased groundcover following logging.

4/ Estimated using intuition. Decrease is due to assumed clearing of adjacent forests.

5/ Assumed a 10 percent reduction in HQI values over a 50 year period due to land loss, canal building, etc. Sufficient data do not exist to define this matter more precisely.

TABLE G-3-2
ACTUAL AND PROJECTED HABITAT QUALITY INDICES
FOR PLANS 4 AND 9

Habitat Type	1980	1990	2000	2010	2020	2030
	Year					
Late Successional Bottomland Hardwood Forest	0.575	0.581	0.587	0.593	0.599	0.605[1/]
Early Successional Bottomland Hardwood and Composition Unknown Forest	0.432	0.446	0.460	0.479	0.488	0.504[2/]
Cypress-Tupelo and Bottomland Hardwood/Cypress-Tupelo Mixed Forest	0.670	0.670	0.670	0.670	0.670	0.670[3/]
Open Land	0.256	0.256	0.256	0.256	0.256	0.256[4/]
Fresh Marsh and Delta	0.668	0.655	0.642	0.629	0.616	0.601[5/]
Brackish Marsh	0.630	0.617	0.604	0.591	0.578	0.567[5/]
Saline Marsh	0.535	0.524	0.513	0.502	0.491	0.481[5/]

[1/]0.605 equals the present Habitat Quality Index (HQI) of grazed late successional bottomland hardwood forest at Old River.

[2/]0.504 equals the mid-point between 1980 HQI values for early and late successional bottomland hardwood forest.

[3/]Assumed to stay the same due to the cancelling effect of logging timber and increased groundcover following logging.

[4/]No change in HQI would occur due to environmental easements.

[5/]Assumed a 10 percent reduction in HQI values over a 50 year period due to land loss canal building, etc. Sufficient data do not exist to define this matter more precisely.

TABLE G-3-3
ACTUAL AND PROJECTED HABITAT QUALITY INDICES
FOR PLAN 7

Habitat Type	1980	1990	Year 2000	2010	2020	2030
Late Successional Bottomland Hardwood Forest	0.575	0.581	0.587	0.593	0.599	0.605[1/]
Early Successional Bottomland Hardwood and Composition Unknown Forest	0.432	0.446	0.460	0.474	0.488	0.504[2/]
Cypress-Tupelo and Bottomland Hardwood/Cypress-Tupelo Mixed Forest	0.670	0.670	0.670	0.670	0.670	0.670[3/]
Open Land	0.256	0.245	0.234	0.223	0.212	0.200[4/]
Fresh Marsh and Delta	0.668	0.641	0.614	0.587	0.560	0.534[5/]
Brackish Marsh	0.630	0.605	0.580	0.555	0.530	0.504[5/]
Saline Marsh	0.535	0.514	0.493	0.472	0.451	0.428[5/]

[1/] 0.605 equals the present Habitat Quality Index (HQI) of grazed late successional bottomland hardwood forest at Old River.

[2/] 0.504 equals the mid-point between 1980 HQI values for early and late successional bottomland hardwood forest.

[3/] Assumed to stay the same due to the cancelling effect of logging timber and increased groundcover following logging.

[4/] Estimated using intuition. Decrease is due to assumed clearing of adjacent forests.

[5/] Assumed a 20 percent reduction in HQI values over a 50 year period due to accelerated land loss following reduction of river overflow and influence. Sufficient data do not exist to define this matter more precisely.

Preservation Credit

G.3.3. Preservation credit for bottomland hardwood fee lands was calculated in a manner similar to that of management potential by subtracting the annualized HQI of lands without purchase from the annualized HQI of lands with purchase. In this case, it was assumed that 80 percent of the potential purchase area would become agricultural land in the future and that the relative value indices for bottomland hardwoods and open land were 0.9 and 0.1, respectively. Preservation credit was figured as follows:

<u>With Purchase</u>

$$\frac{0.575^{1/}(1.0) + 0.745^{2/}(1.0)}{2}$$

minus <u>Without Purchase</u>

$$\frac{0.575^{1/}(1.0) + [0.604^{3/}(0.2)^{4/}(0.9)^{5/} + 0.20^{6/}(0.8)^{7/}(0.1)^{8/}]}{2} = 0.31$$

1/ 1980 HQI grazed land in floodway

2/ 1980 HQI ungrazed land at Old River

3/ 1980 HQI grazed land at Old River

4/ Amount of initial land remaining in forest in 2030

5/ Relative value index for bottomland hardwood

6/ 2030 HQI for open land

7/ Amount of initial land in open land category in 2030

8/ Relative Value Index for open land

Habitat Evaluation Analyses

G.3.4. Gains or losses of habitat units for the future without-project condition and the three final plans are shown by major land use categories in Table G-3-4.

TABLE G-3-4

ANNUALIZED GAINS OR LOSSES OF HABITAT UNITS (1,000's)

Land Use Category	Future Without Project Condition	Plan 4	Plan 7	Plan 9
Bottomland Forest[1/] Open Land	-4.45	+41.0	-6.40	+41.0
Swamp[2/]	-1.55	+2.7	-11.1	+20.7
Marsh[3/]	0.00	-0.2	-3.0[4/]	-0.2

[1/] Includes early and late successional bottomland hardwood forest open land, and composition unknown forest.

[2/] Includes cypress-tupelo swamp and cypress-tupelo mixed with bottomland hardwoods.

[3/] Includes fresh, brackish, and saline marsh and delta.

[4/] Minus 19.2 if the entire Avoca Island levee were built.

Section 4 - MITIGATION NEEDS

G.4.1. Mitigation needs were calculated using the data generated in the habitat evaluation analyses. This data was processed using the US Army Corps of Engineers LMVD-HES computer program. These needs will be discussed for the future without-project condition and for each of the three final plans.

Future Without - Project Condition

G.4.2. Losses induced by the continued raising of the floodway protection levees would include 3,016 annualized habitat units (AHU) of flooded forest, 1,550 AHU's of swamp, and 4,450 AHU's of bottomland forest - open land (bottomland forest and open land were combined as open land is generally produced by clearing bottomland forests). The best method to mitigate for losses of flooded forest and swamp would be to re-open the Wax Lake overbank area to river overflow flooding. To do this, it would be necessary to build a levee from the Wax Lake Outlet to the Bayou Sale ridge. This levee would lie south of and parallel to the Southern Pacific railroad tracks. The existing levee along the western bank of Wax Lake Outlet and the northern bank of the Gulf Intracoastal Waterway would then be degraded to ground level and the existing bayou would be re-connected to Wax Lake Outlet. Mitigation for the loss of 3,016 AHU's of flooded forest would be accomplished by this action since the 7,800 acres of swamp in the overbank area are probably flooded approximately 2 months at the present time and thus have a HQI of approximately 0.2. By opening the area to river and tidal influence, the entire area would assume the HQI for flooded cypress-tupelo which is 0.55. Accordingly, the management potential would be 0.35 (0.55 - 0.2). The acres necessary for mitigation are calculated as follows:

$$\text{Acres} = \frac{\text{AHU lost}}{\text{management potential}} = \frac{3016}{.35} = 8617$$

Thus 7,800 acres would replace most of the necessary AHU's.

G.4.3. Mitigation for loss of 1,550 AHU's of swamp would be accomplished if it is assumed that re-connecting this area to river overflow has a management potential of 0.2 (due to time and personnel constraints, it was not possible to determine actual management potential). Mitigation for loss of 4,450 AHU's of bottomland forest - open land habitat would be accomplished by the purchase and management of 12,000 acres of bottomland hardwood forest within the floodway (calculated using a management potential of 0.07 and a preservation credit of 0.31 as discussed previously in the section on habitat evaluation analysis).

G.4.4 Costs for the mitigation measures outlined above would be as shown on Table G-4-1.

TABLE G-4-1

COSTS OF MITIGATION MEASURES FOR THE FUTURE WITHOUT-PROJECT CONDITION

Action	Total First Costs	Annual I&A[1/]	Annual O&M[2/]	Total Annual Costs
Re-open Wax Lake Overbank Area	$40,000,000[3/]	$3,052,000	none	$3,052,000
Purchase 12,000 Acres of Bottomland Hardwood Forest	9,403,000[4/]	717,000	18,000[5/]	735,000
Totals	$49,403,000	$3,769,000	$18,000	$3,787,000

1/ Interest and Amortization - 7 5/8 percent for 100 years.

2/ Operation and Maintenance.

3/ Approximately one-half the cost of widening Wax Lake Overbank as proposed in the recommended plan. This mitigation proposal would not have the major relocation costs associated with widening the entire overbank area.

4/ Based upon a unit land cost of $580 per acre, contingency costs of 25 percent, acquisition costs of $4,000 per tract for 82 traces, development costs of $30 per acre, and total resettlement cost of $75,000.

5/ Assumed to be $1.50 per acre.

Plan 7 (NED)

G.4.5. Losses induced by this plan would be about 8,500 AHU's of flooded forest habitat, 6,400 AHU's of bottomland forest - open land habitat, 11,100 AHU's of swamp habitat and 3,000 AHU's of marsh habitat (19,200 if the entire Avoca Island levee were built).

G.4.6. The best method to mitigate for the loss of flooded forest habitat and about a third of the swamp habitat would be to build the Buffalo Cove management unit. (This assumes that building the unit would actually benefit aquatic resources). This action would maintain the present water levels and thus prevent clearing. At the present time, 23,910 acres of early successional bottomland hardwoods and 11,730 acres of cypress-tupelo are flooded yearly in Buffalo Cove. In the future with Plan 7, only 5,100 acres of early successional and 6,120 acres of cypress-tupelo forest would be flooded. Therefore, construction of the management unit would preserve flooding on 18,797 acres of early successional forest with an HQI of 0.27 for a total of 5,075 AHU's preserved. Flooding would also be retained on 5,610 acres of cypress-tupelo forest with an HQI of 0.55 for flooded forest, for a total of 3,085 AHU's of flooded forest preserved. This flooding would also preserve about 4,000 AHU's of swamp habitat if one assumes a preservation credit of 1.0 for swampland saved by building the management unit. Thus, construction of the management unit would preserve a total of about 8,200 AHU's of flooded forest habitat and 4,000 AHU's of swamp habitat which would mostly mitigate for the overall 8,500 AHU's loss of flooded forest habitat. To mitigate for the remaining 7,100 AHU's of swamp habitat it might be possible to build a water diversion structure which would direct sufficient Mississippi River water into existing swampland south of the river downstream from Donaldsonville, Louisiana, so that the habitat quality index of the swamps would be raised in a manner similar to that described for the future without project mitigation plan. A structure similar to the one described below for marsh habitat mitigation would probably suffice.

G.4.7. To mitigate for loss of 6,400 AHU's of bottomland forest - open land habitat it would be necessary to purchase and manage, as described for the future without-project condition, 16,800 acres of bottomland hardwood habitat.

G.4.8. To mitigate for loss of 3,000 AHU's of marshland, it is proposed that management of marsh through freshwater introduction be carried out by diverting water from the Mississippi River into suitable areas adjacent to the river.

G.4.9. It is not possible at this time to estimate precisely how much land would have to be managed, nor is it possible to estimate how much productivity could be increased through freshwater introduction. To replace the entire project-induced loss due to building the first extension of the Avoca Island levee could require the management of 15,000 acres (assuming a management potential of 0.2). A recent report (Gagliano 1981) on marsh deterioration in Louisiana stated that water diversion structures could be built which would benefit an area of up to 30,000 acres in extent. One structure of this type would probably be adequate to meet the mitigation needs of plan 7.

G.4.10. If the entire Avoca Island levee were built, additional mitigation would be necessary. To replace the remainder of the project-induced loss which could result from implementation of plan 7 (16,200 AHU's) could require the management of over 100,000 acres (assuming a management potential of 0.2). Four structures of this type mentioned previously would probably be adequate to meet the mitigation needs of plan 7. Estimated cost for implementing mitigation measures for this plan are shown in Table G-4-2.

Plans 4 (EQ) and 9 (Recommended)

G.4.11. Mitigation needs for plans 4 and 9 would arise due to the estimated loss of 200 annualized habitat units of marsh habitat. Since implementation of both of these plans would result in a net gain of over 40,000 AHU's of bottomland hardwood-open land habitat and almost 3,000 AHU's of swamp habitat, it was assumed that these gains would offset the small lost of marsh habitat.

TABLE G-4-2

SUMMARY OF ESTIMATED MITIGATION COSTS FOR PLAN 7 (NED)

Action	Total First Costs	Annual I&A[1/]	Annual O&M[2/]	Total Annual Costs
Purchase of 16,800 acres of Bottomland Hardwood Forest	$13,144,000[3/]	$1,003,000	$25,000[4/]	$1,028,000
Freshwater Diversion (Swamp)	15,000,000	1,145,000	-	1,145,000
Freshwater Diversion (Marsh)	15,000,000[5/] (1,000,000,000)[6/]	1,145,000[5/] (7,630,000)[6/]	- -	1,145,000[5/] (7,630,000)[6/]
Implement Buffalo Cove Management Unit	3,700,000[7/]	282,000	10,000	292,000
TOTAL	$46,844,000[5/] ($131,844,000)[6/]	$3,575,000[5/] ($10,060,000)[6/]	35,000 35,000	$3,610,000[5/] ($10,095,000)[6/]

1/ Interest and Amortization - 7 5/8 percent for 100 years.

2/ Operation and Maintenance.

3/ Based on a unit land cost of $580 per acre, contingency costs of 25 percent, acquisition costs of $4,000 per tract for 110 tracts, development costs of $30 per acre, and total resettlement cost of $20,000.

4/ Assumed to be $1.50 per acre.

5/ Cost with first levee extension only.

6/ Cost with entire levee extension.

7/ Derived from data used in cost estimate preparation for plan 4.

Section 5 - METHODOLOGY FOR ATCHAFALAYA BASIN FLOODWAY LAND USE - HABITAT TYPE PROJECTIONS

G.5.1. Vegetation associations and habitat types (both land and water) within the Atchafalaya Basin form a complex and continually changing pattern. The changing nature of this pattern is due primarily to plant successional changes induced by changing water levels and hydroperiods coupled with sediment deposition in open water and overbank areas. These naturally occurring changes have created a number of distinct vegetation associations and habitat types which have been further altered by human activities such as land clearing for agricultural purposes or canal dredging for mineral extraction. These habitat types are discussed in detail in Appendix A.

Methodology for Projecting Habitat Changes

G.5.2. In order to predict and project future habitat conditions for the various project alternatives, it was necessary to evaluate the effects of changing water levels and hydroperiods, sedimentation, land clearing for agriculture, and the ongoing ecological process of natural succession on the existing habitat types. To do this, a team composed of biologists from the US Fish and Wildlife Service and the US Army Corps of Engineers was formed. This team utilized its personal knowledge of the functioning of the project area ecosystems, augmented by information received from a Corps economist and a number of professional foresters and ecologists, in formulating a methodology for projecting the habitat changes which might be expected to occur with the various alternative plans evaluated. The methodology decided upon is described as follows:

LAND CLEARING PROJECTIONS

G.5.3. Land clearing projections were made for all plans by using hydrologic and sedimentation data supplied by the Corps and by using the following assumptions as a basis for calculating projected acreages to be cleared.

G.5.4. All lands flood free 3 out of 5 years from 1 June through 30 November were assumed to be suitable for agricultural use (except certain floodway lands south of river mile 80 which are mostly state-owned or which occur in such small tracts as to be infeasible to farm).

G.5.5. Land clearing was assumed to proceed from north to south as it has historically, and the floodway proper was divided into three zones to reflect this. These zones are as follows:

- o Zone a. Henderson and Alabama Bayou - Land clearing to begin in 1980.

- o Zone b. Bayou des Glaises, Warner Lake, Cocodrie Swamp, Beau Bayou, Pigeon Bay, Buffalo Cove, and Flat Lake - Land clearing to begin in 1995.

- o Zone c. Upper Belle River, Crevasse, and Sixmile Lake - No clearing to occur during project life.

G.5.6. Not all lands suitable for agricultural use would be cleared due to factors such as limited access or tract size. It was assumed that 80 percent of the suitable land in zones a and b and in the backwater area northeast of Morgan City could ultimately be cleared.

G.5.7. It was assumed that land clearing would start slowly, accelerate and then taper off as has been the case historically. The following percentage factors were applied to the acres suitable for clearing to calculate the acres that would probably be cleared.

	Percent Cleared		
Year	Zone a	Zone b	Zone c
1980	0	0	0
1990	15	0	0
2000	60	15	0
2010	76	60	0
2020	78	76	0
2030	80	78	0

These same clearing trends were used in calculations for the backwater area northeast of Morgan City, but since much of this area has already been cleared, it was necessary to fit the existing cleared acres into the cumulative land clearing curve from which the above percent cleared figures were derived. After doing this, the amount of land which remained to be cleared could be calculated (see Appendix D for this curve).

TERRESTRIAL VEGETATIVE SUCCESSION PROJECTIONS

G.5.8. Vegetative succession projections were made utilizing Corps hydrologic and sedimentation data and the following assumptions.

o It was assumed that future sediment deposition in the floodway would not adversely affect bottomland hardwood habitat types nor cause them to succeed to a different type.

o Due to the stand age of the early successional bottomland hardwood areas in the Henderson unit, it was assumed that these areas would become mid-successional bottomland hardwood areas by 1990.

o It was assumed, following field investigations, that cypress-tupelo areas would succeed to a cypress-tupelo/bottomland hardwood mix when lowering of water levels and shortening of hydroperiods caused these areas to be flood free 3 out of 5 years during the 1 June through 30 November time period. (Some mixing was also recognized in areas wetter than this, but this could not be quantified.) This mixed forest type was assumed to be a mix of cypress-tupelo with willow or cottonwood and sycamore, in areas receiving significant sediment impact and a mix of cypress-tupelo with ash and maple in areas not receiving significant sediment impact.

o In some areas, it was not possible to predict what type of succession would occur (due to lack of data on stand ages or lack of hydrologic data) and in such areas it was assumed that the forest would convert to a forested unknown category.

AQUATIC HABITAT SUCCESSIONAL PROJECTIONS

G.5.9. Aquatic habitat successional projections were made using Corps hydrologic and sedimentation data. These projections consisted basically of calculating the number of acres of existing water bodies that would be eliminated by sedimentation and assigning the vegetative community that would grow on the newly formed accretion lands to the forested unknown terrestrial category (as requested by the US Environmental Protection Agency).

Section 6 - PREPARATION OF DESIRED HYDROGRAPHS

G.6.1. In November of 1979, representatives of the US Army Corps of Engineers (Corps), US Fish and Wildlife Service (US FWS), and US Environmental Protection Agency (EPA) met to propose theoretical desired hydrographs for each of the management unit areas which reflected what each agency then felt would be a desirable condition to attempt to achieve in order to preserve the biological resources of the lower Atchafalaya Basin floodway. The rationale used in preparing these hydrographs is discussed in the following paragraphs as well as subsequent modification of three of the hydrographs at the insistence of the EPA. Also discussed, are subsequent reservations held by the Corps regarding the desirability of attempting to implement the theoretical hydrographs. These reservations developed since the original November 1979 meetings.

G.6.2. The rationale used in preparing the desired hydrographs was as follows. The hydrographs were drawn so as to mimic, somewhat, the actual 1965 hydrograph, which was considered at that time to be a typical or average year. The peak was established at 15 April, which is the average river peak date. Low points on the hydrographs were established by using either bankfull elevations (estimated and surveyed at various points in the basin in the winter of 1978) or, where no such surveys were done, swamp floor elevations (from Corps survey range line data). A critical date for falling water levels was considered to be 15 June, by which time it was assumed that water should no longer flood dry bottomland hardwood tree species. Hydrographs were drawn so that this forest type would not be flooded past the 15 June date. Data from Corps land-use maps, Corps topographic maps and maps from the US Geological Survey report entitled "Trend Analysis of Vegetation in Louisiana's Atchafalaya River Basin" (O'Neil et al. 1975) were used in determining the needed 15 June flood-free elevations.

G.6.3. The results of this work are shown in Figures G-6-1 through G-6-11 which show the theoretical desired hydrographs prepared during the November 1979 meetings.

G.6.4. At a meeting on 27 August 1980, between the Corps, US FWS, and EPA, it was proposed by EPA that the November 1979 desired hydrographs for Flat Lake, Bayou des Glaises, and Upper Belle River be revised to reflect what EPA considered to be a more accurate reflection

FIGURE G-6-1 THEORITICAL DESIRED HYDROGRAPH FOR HENDERSON

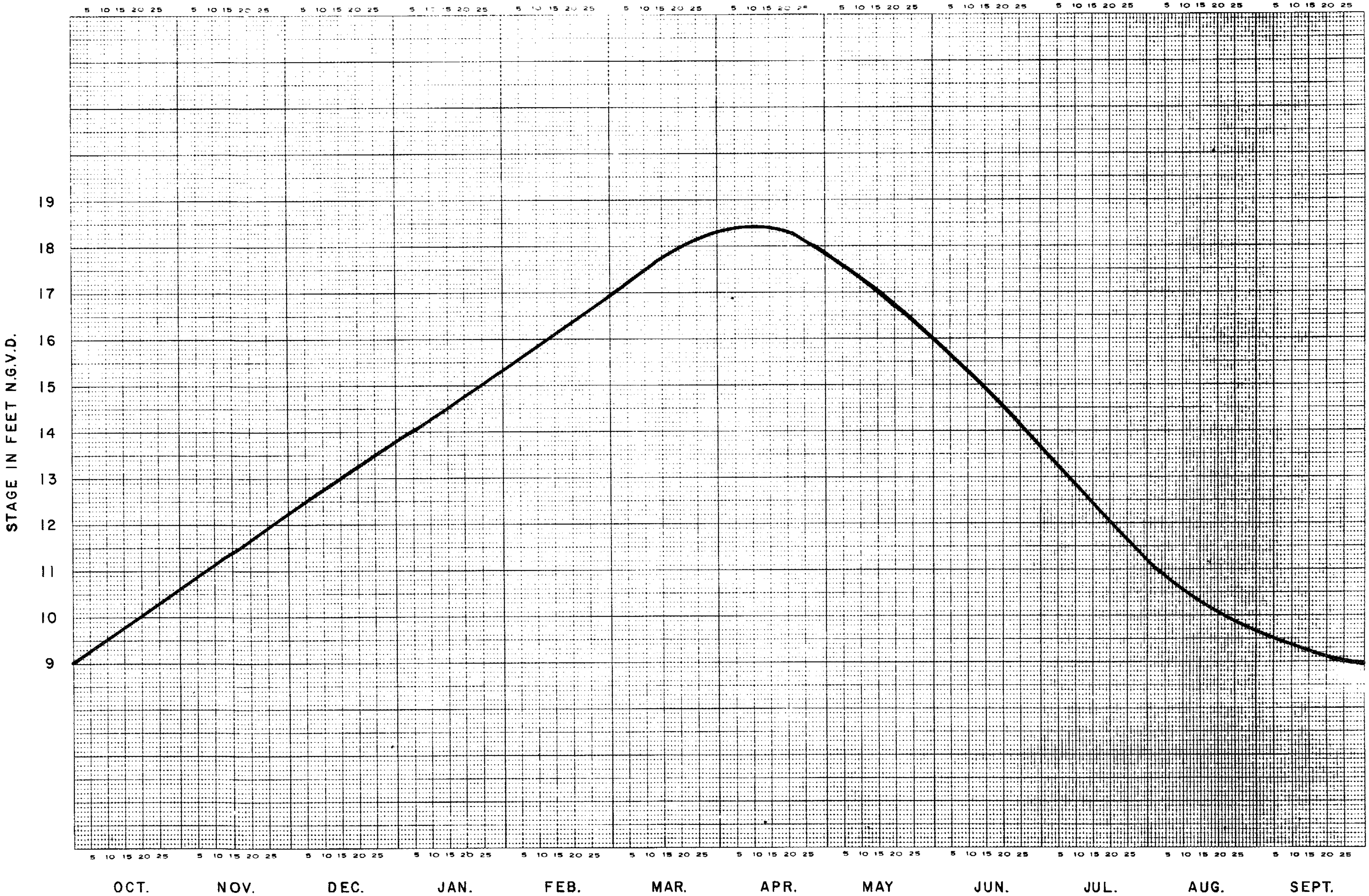


FIGURE G-6-2 THEORETICAL DESIRED HYDROGRAPH FOR ALABAMA BAYOU

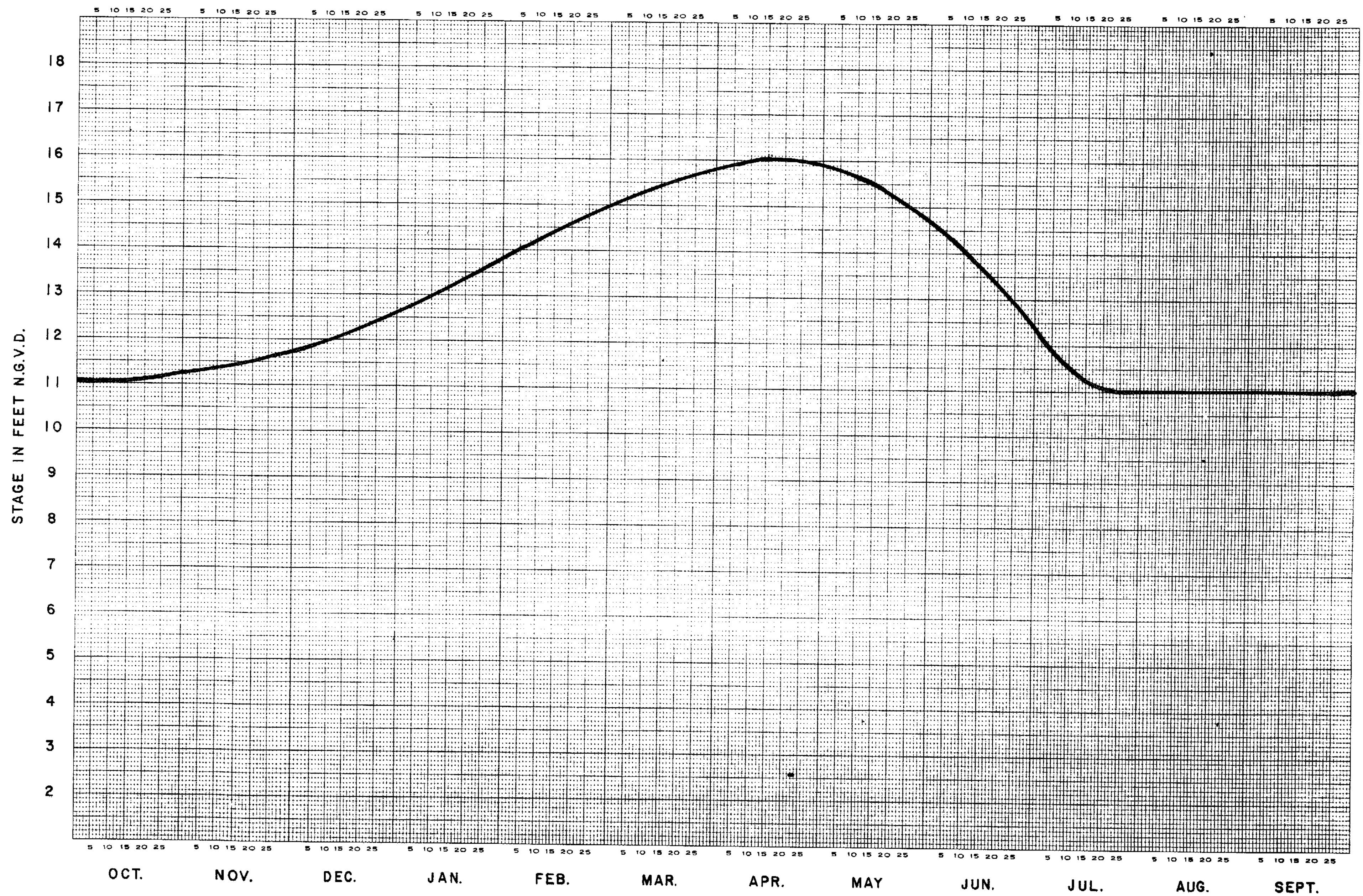


FIGURE G-6-3 THEORETICAL DESIRED HYDROGRAPH FOR WARNER LAKE

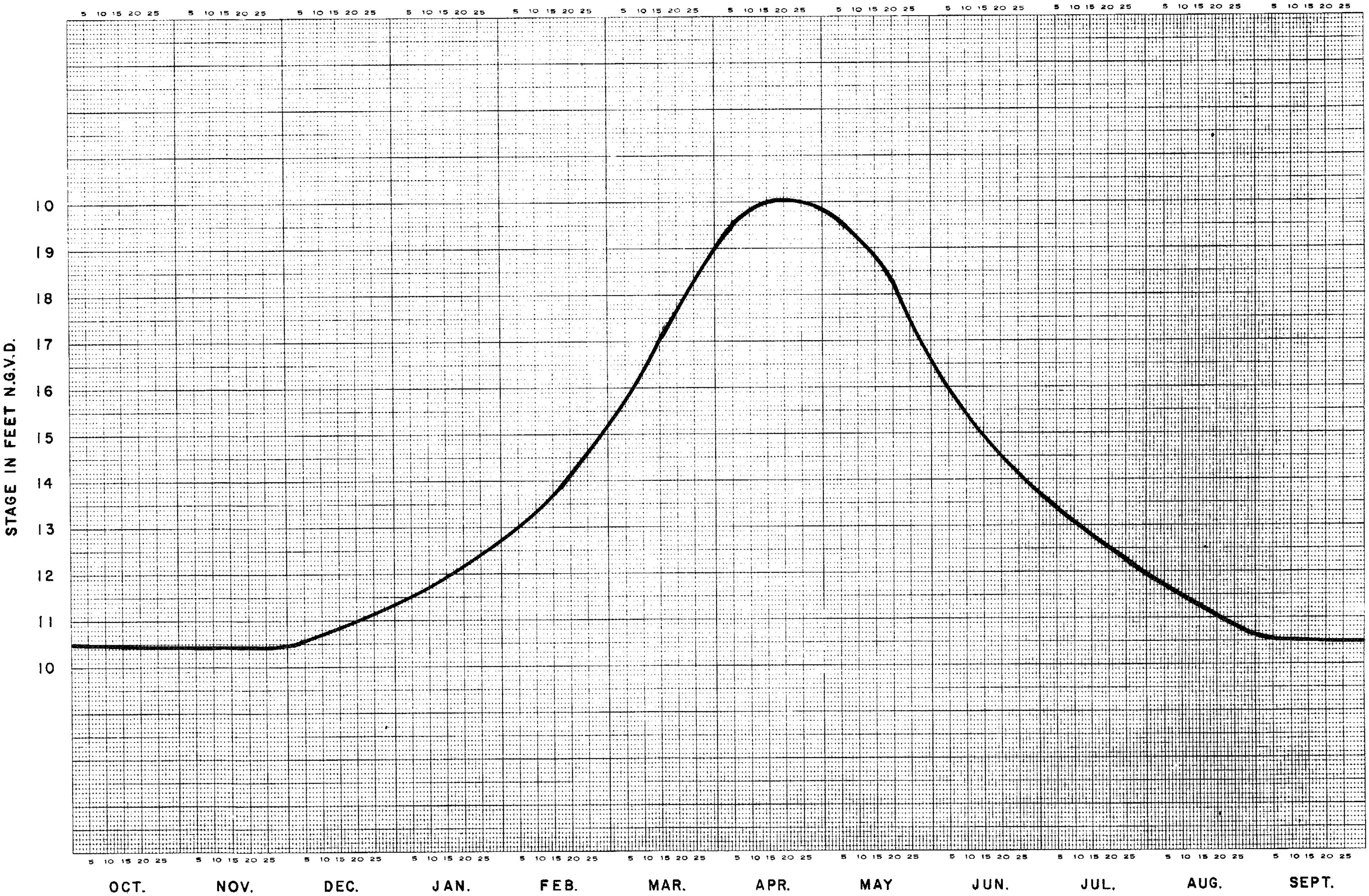


FIGURE G-6-4 THEORETICAL DESIRED HYDROGRAPH FOR COCODRIE SWAMP

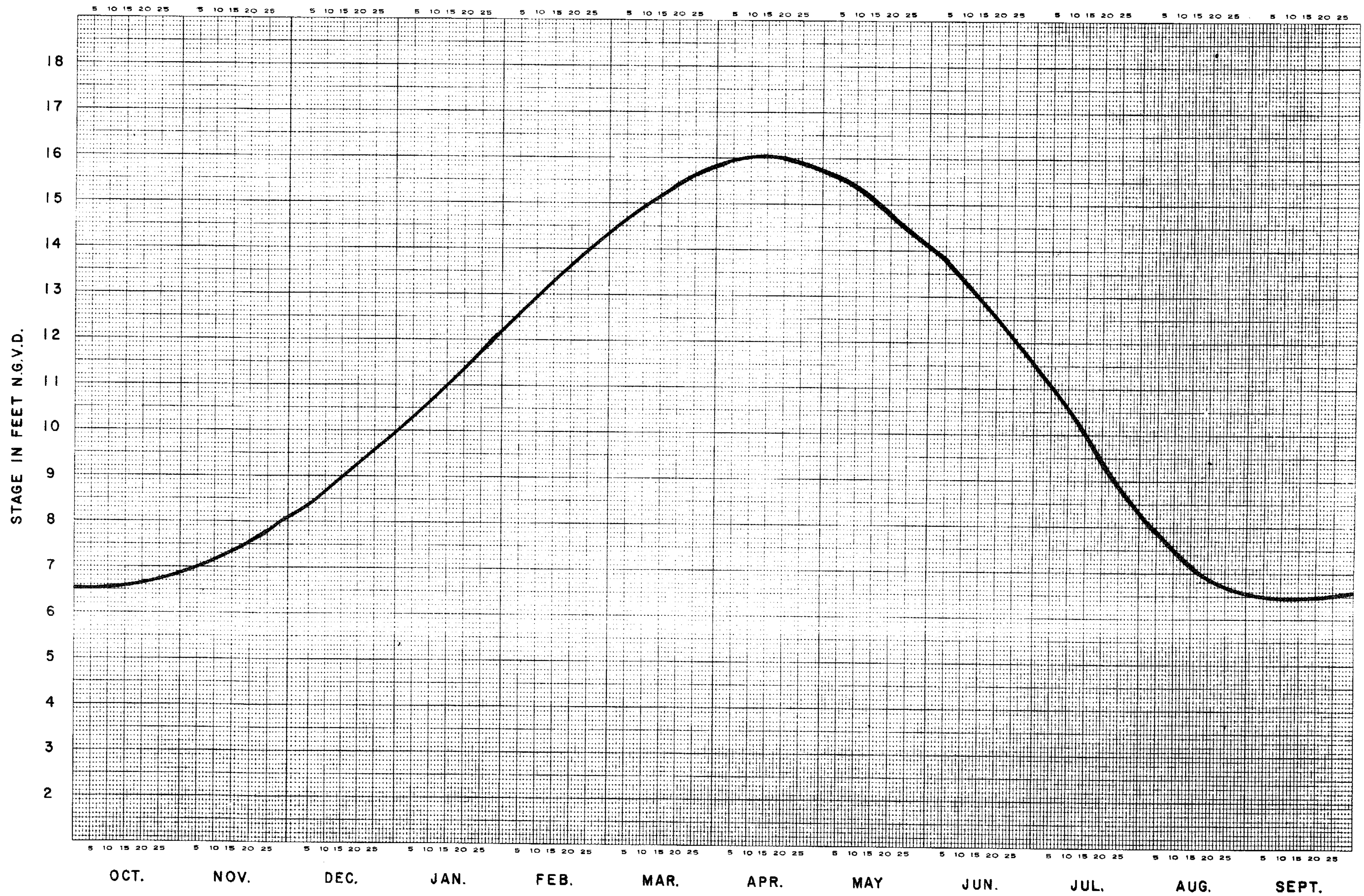


FIGURE G-6-5 THEORETICAL DESIRED HYDROGRAPH FOR BAYOU DES GLAISES

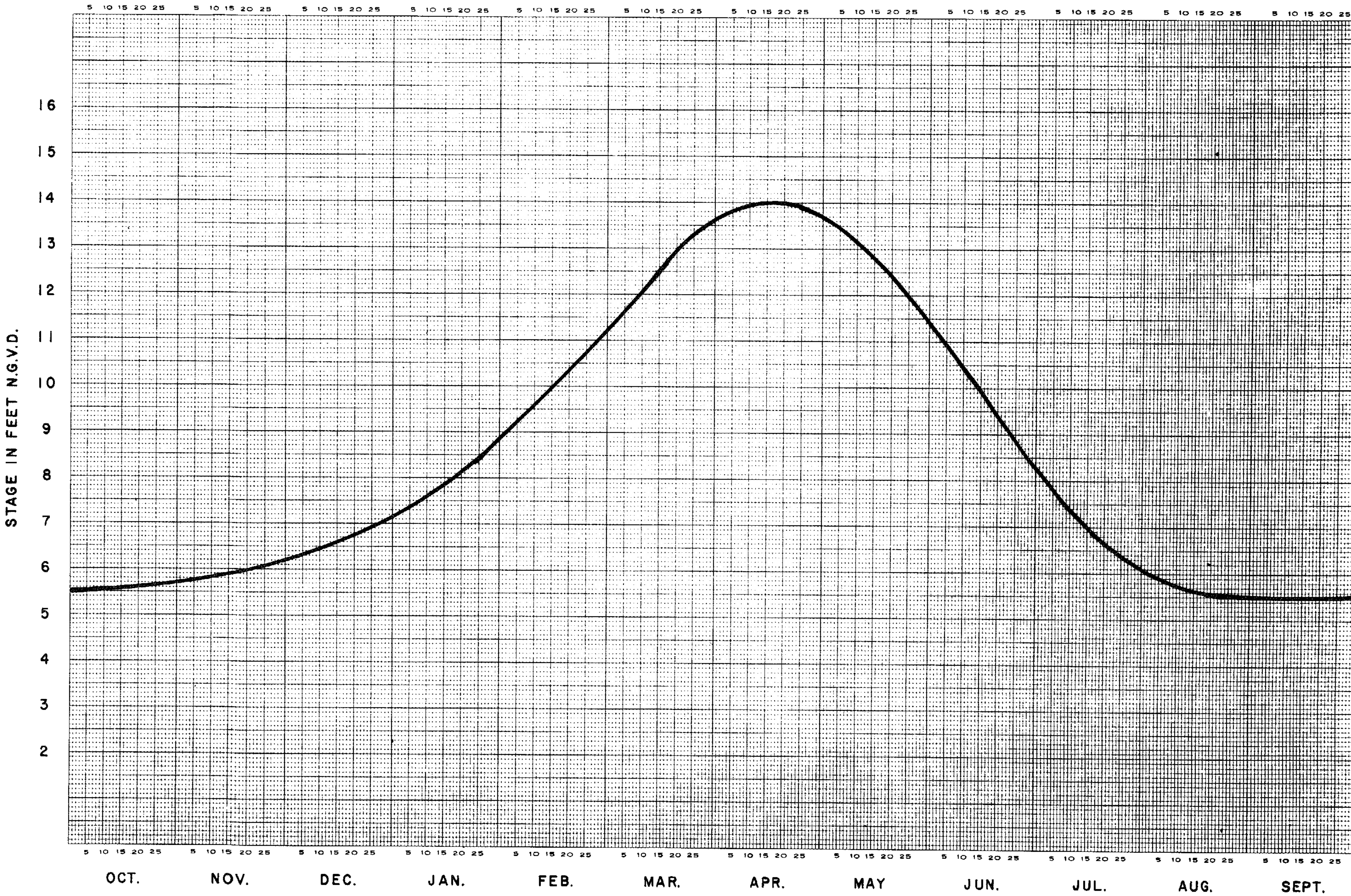


FIGURE G-6-6 THEORETICAL DESIRED HYDROGRAPH FOR BEAU BAYOU

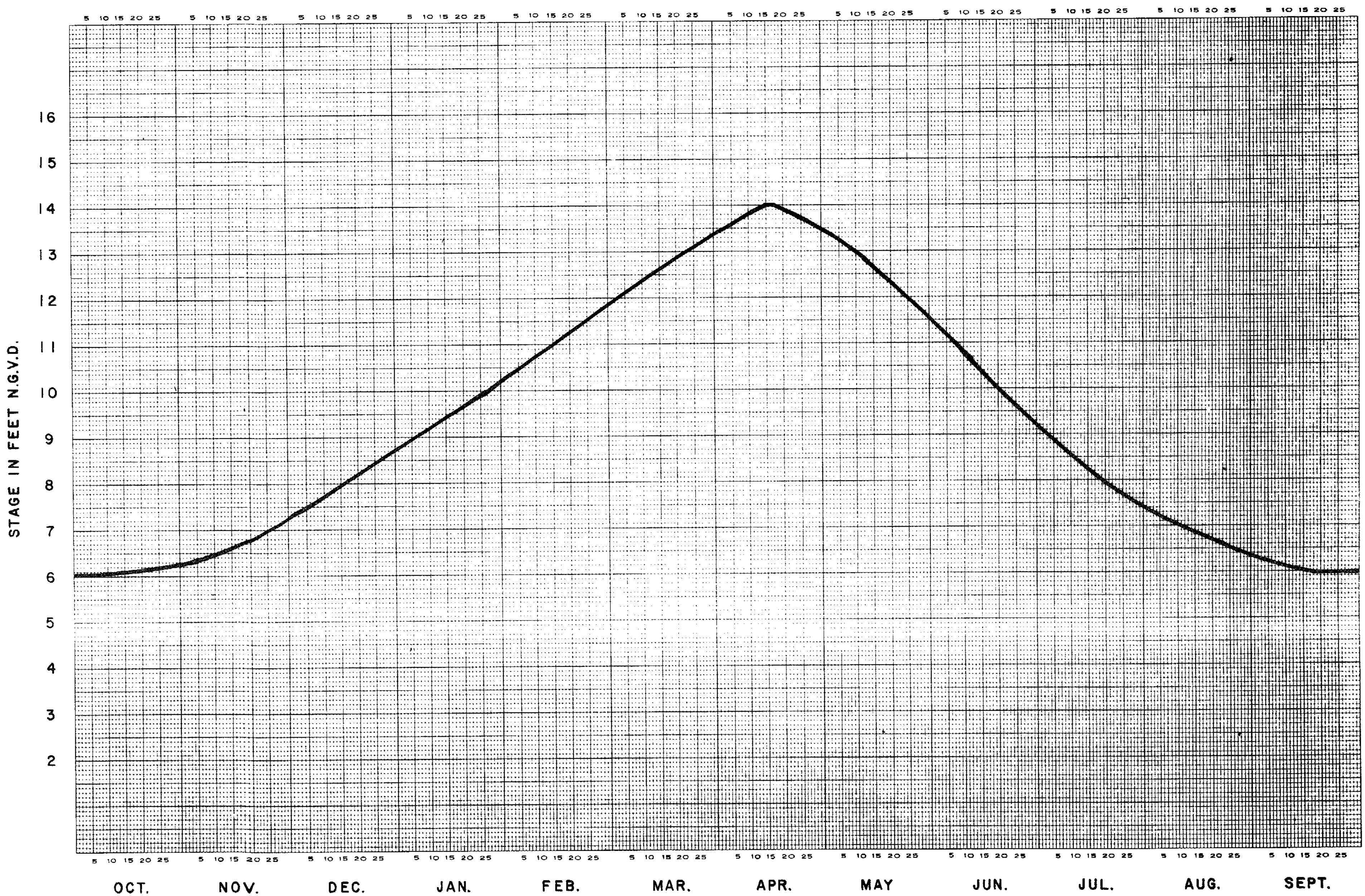


FIGURE G-6-7 THEORETICAL DESIRED HYDROGRAPH FOR PIGEON BAY

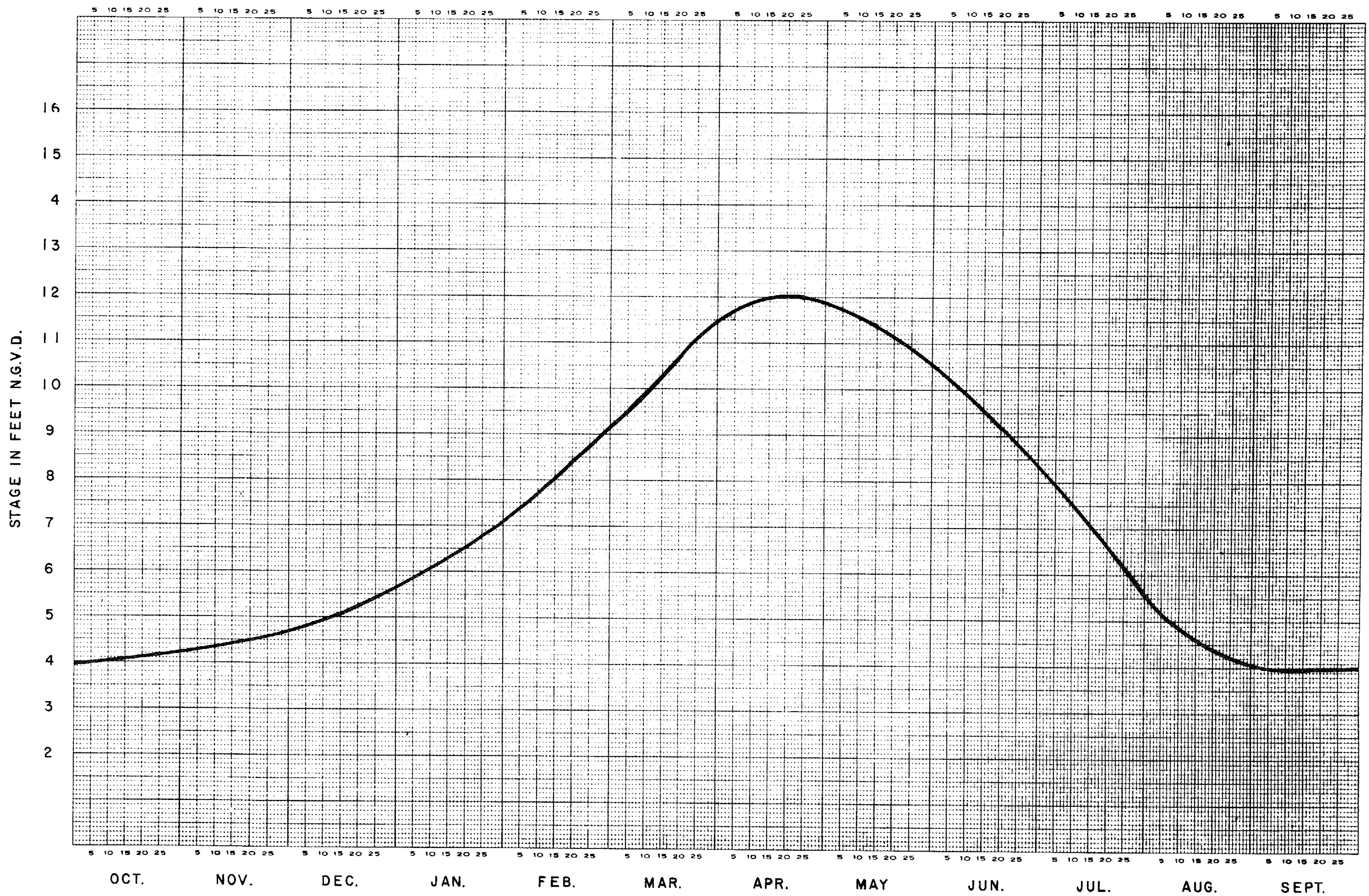


FIGURE G-6-8 THEORETICAL DESIRED HYDROGRAPH FOR BUFFALO COVE

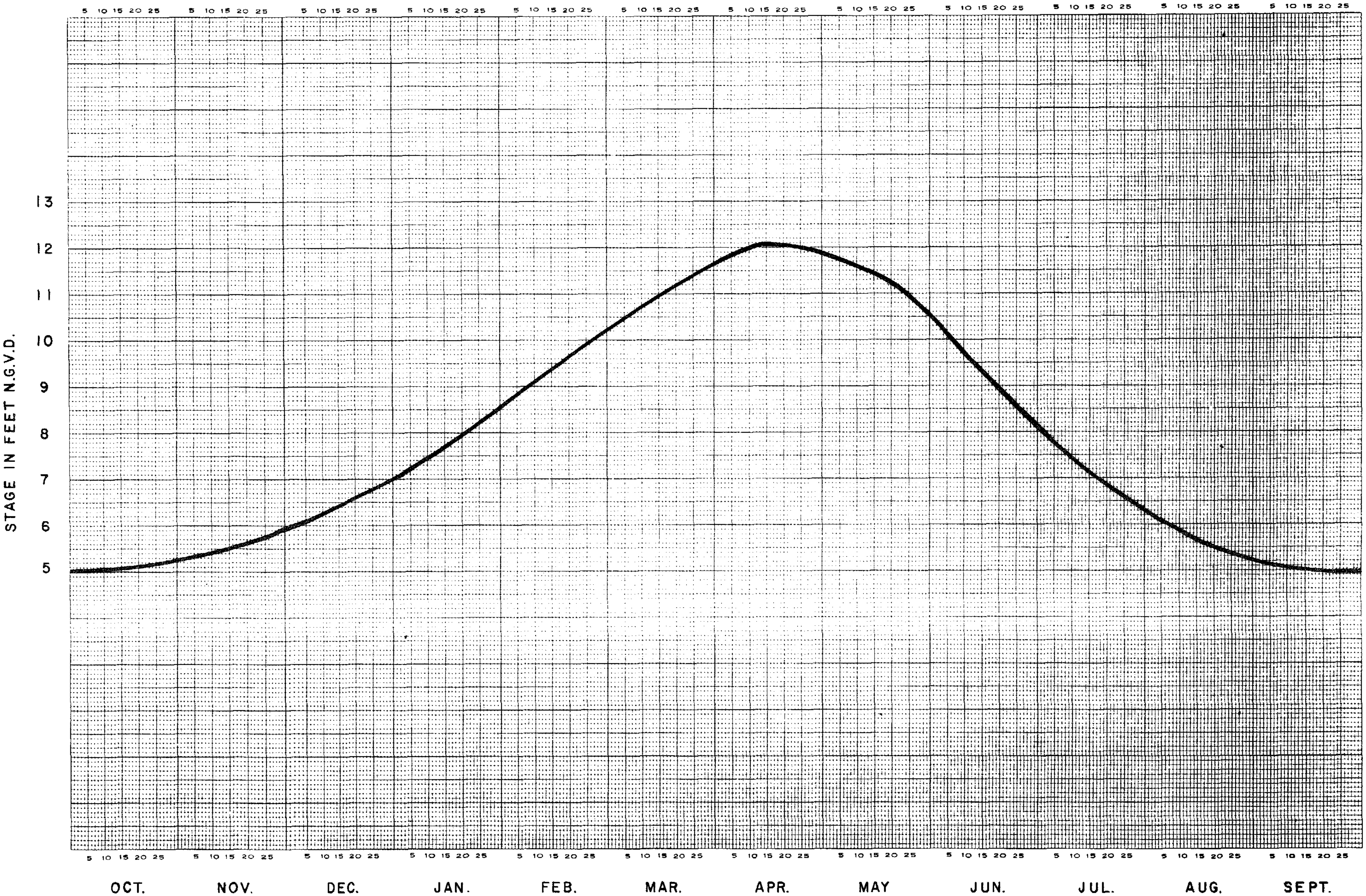


FIGURE G-6-9 THEORETICAL DESIRED HYDROGRAPH FOR FLAT LAKE

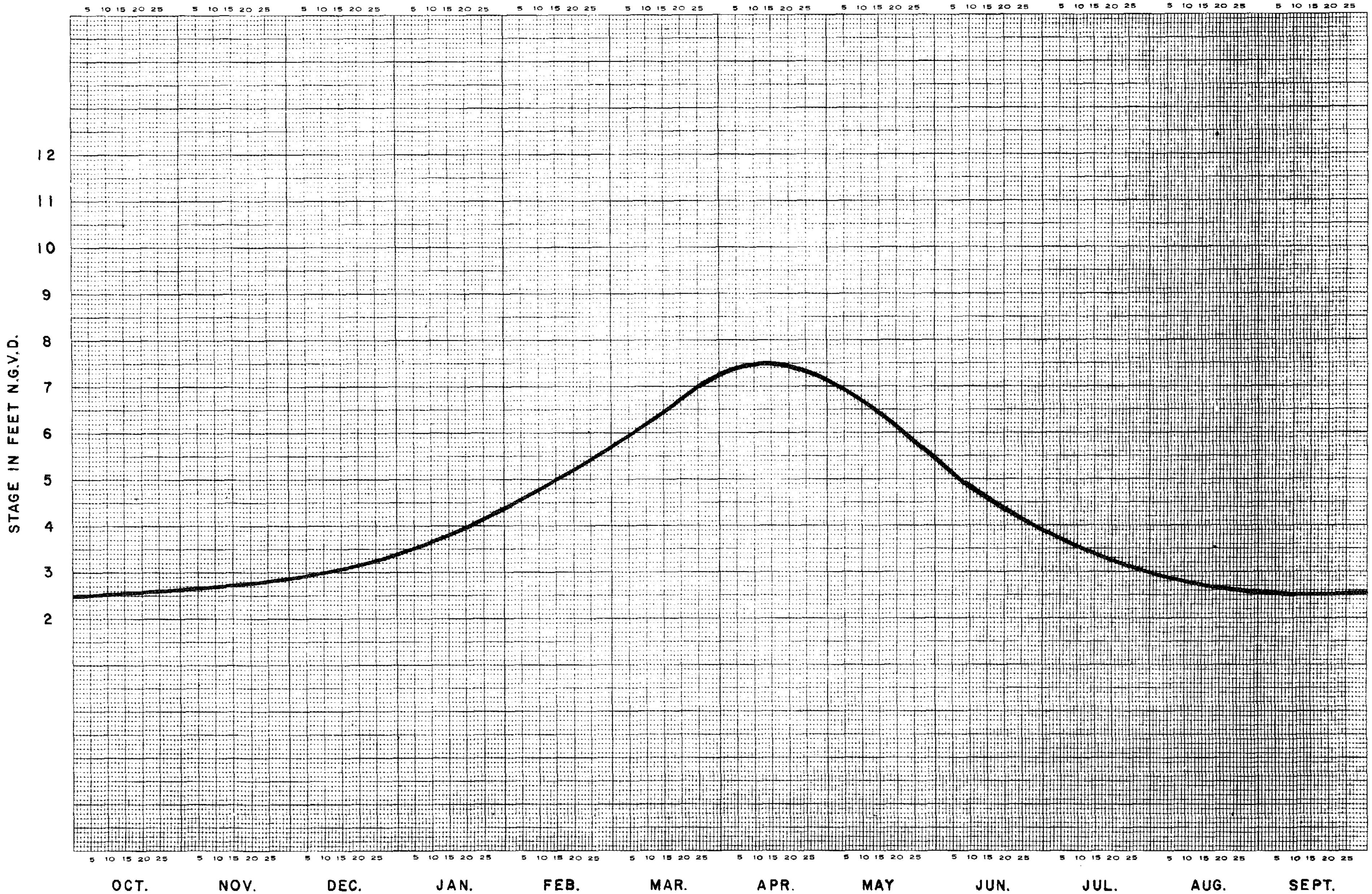


FIGURE G-6-10 THEORETICAL DESIRED HYDROGRAPH FOR SIX MILE LAKE

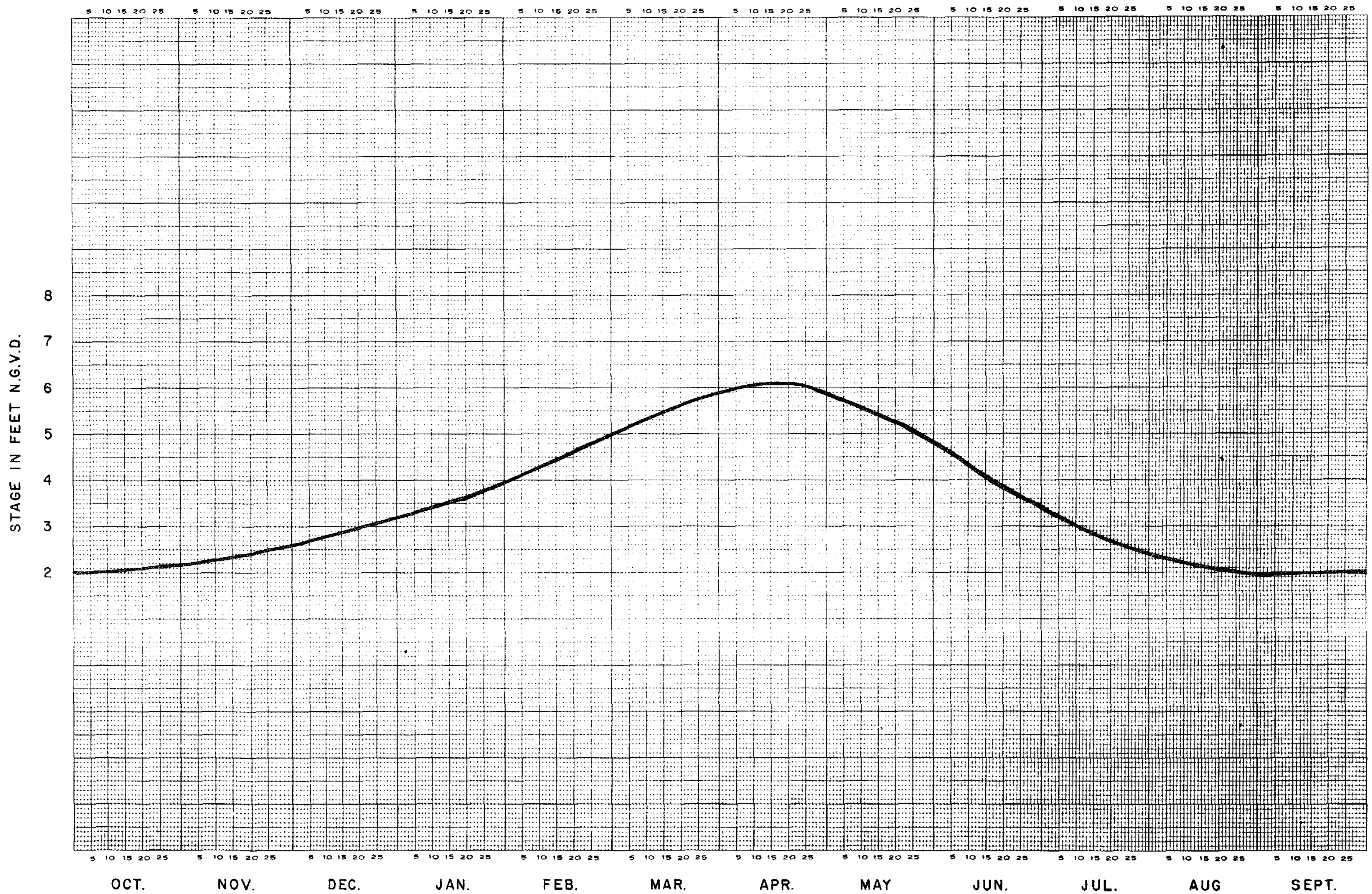
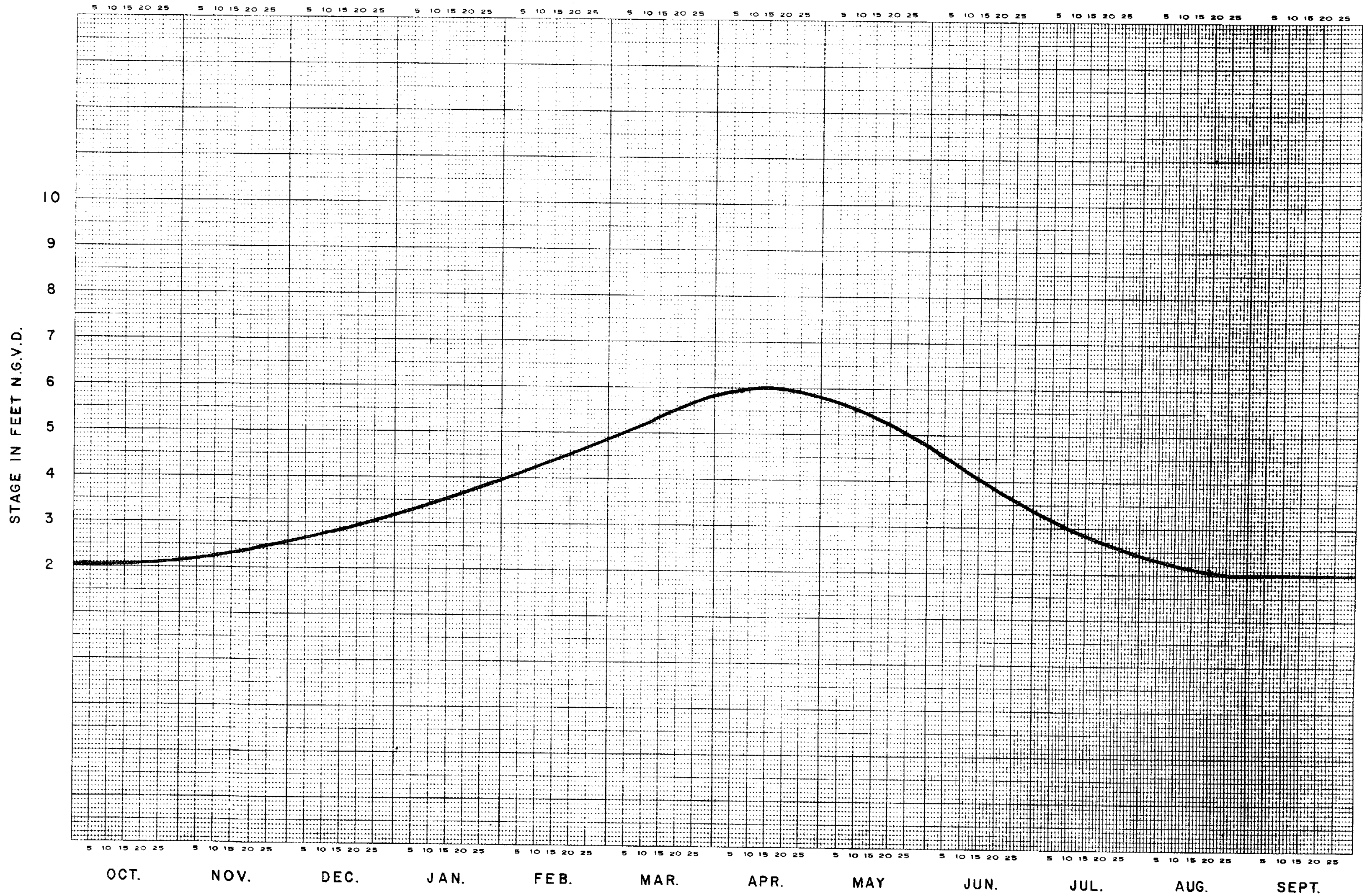


FIGURE G-6-11 THEORETICAL DESIRED HYDROGRAPH FOR UPPER BELL RIVER



of "historic" conditions. These revised theoretical desired hydrographs are shown in Figures G-6-12, G-6-13, and G-6-14.

G.6.5. Since the original November 1979 meetings, the Corps has generated new hydrographs for the floodway which more closely reflect the true nature of the annual hydrograph. These average annual shifted hydrographs are discussed and illustrated in Appendix C. A comparison of these average annual shifted hydrographs with the theoretical desired hydrographs, which were supposed to reflect an average year, revealed that the theoretical desired hydrographs were not really typical or average ones (see Figure G-6-15 through G-6-19 for examples). The theoretical desired hydrographs, in fact, reflect conditions during a year that would be wetter than average and one in which bottomland hardwood areas would experience a longer hydroperiod than would occur under average conditions. Because of this, the Corps no longer considers it desirable to attempt to duplicate the theoretical desired hydrographs, developed in November 1979, for purposes of benefitting the biological resources of the floodway, unless further detailed studies are undertaken to evaluate the possible impacts of such an action.

FIGURE G-6-12 MODIFIED THEORETICAL DESIRED HYDROGRAPH FOR FLAT LAKE

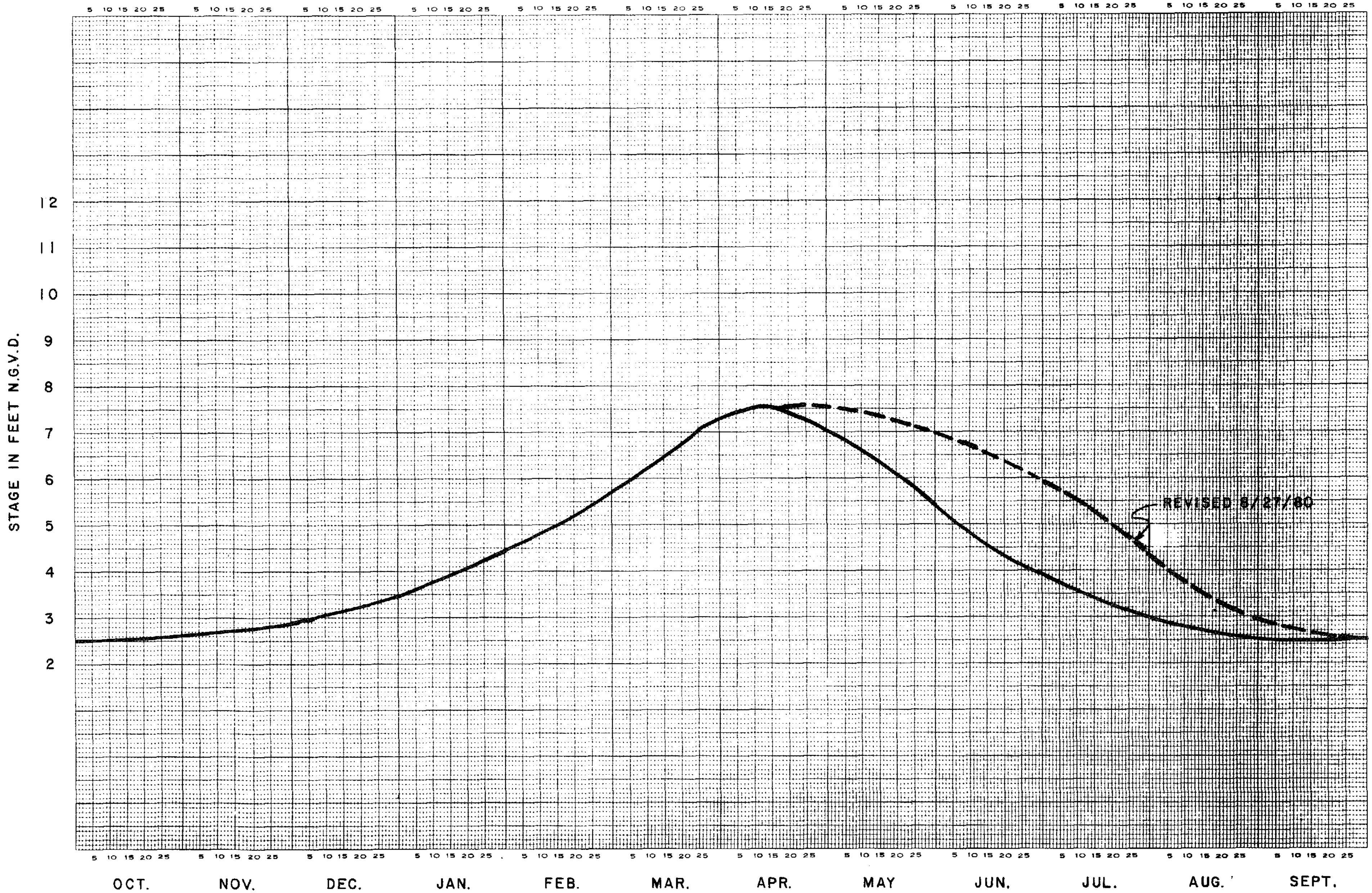


FIGURE G-6-13 MODIFIED THEORETICAL DESIRED HYDROGRAPH FOR BAYOU DES GLAISES

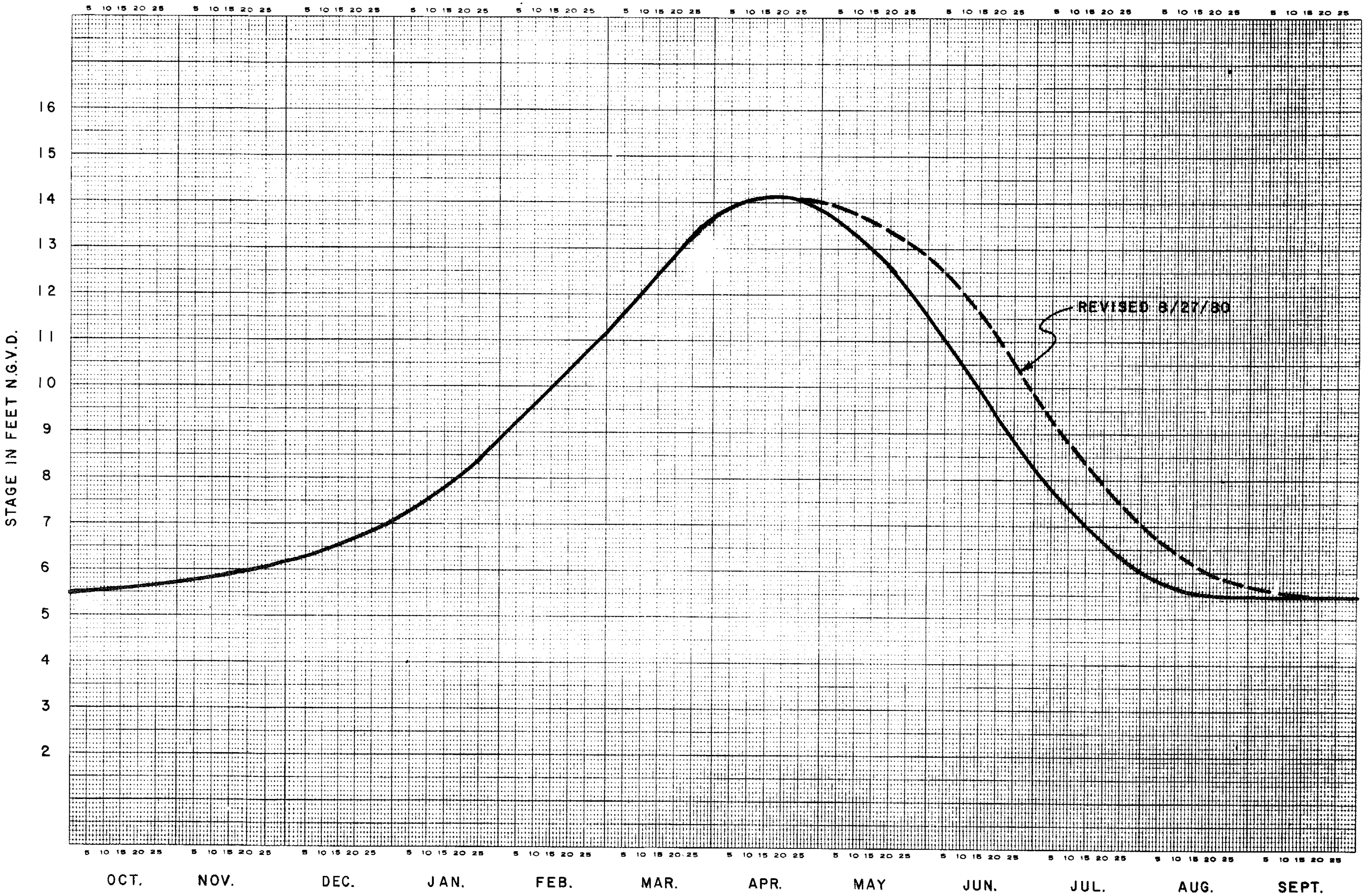


FIGURE G-6-14 MODIFIED THEORETICAL DESIRED HYDROGRAPH FOR UPPER BELLE RIVER

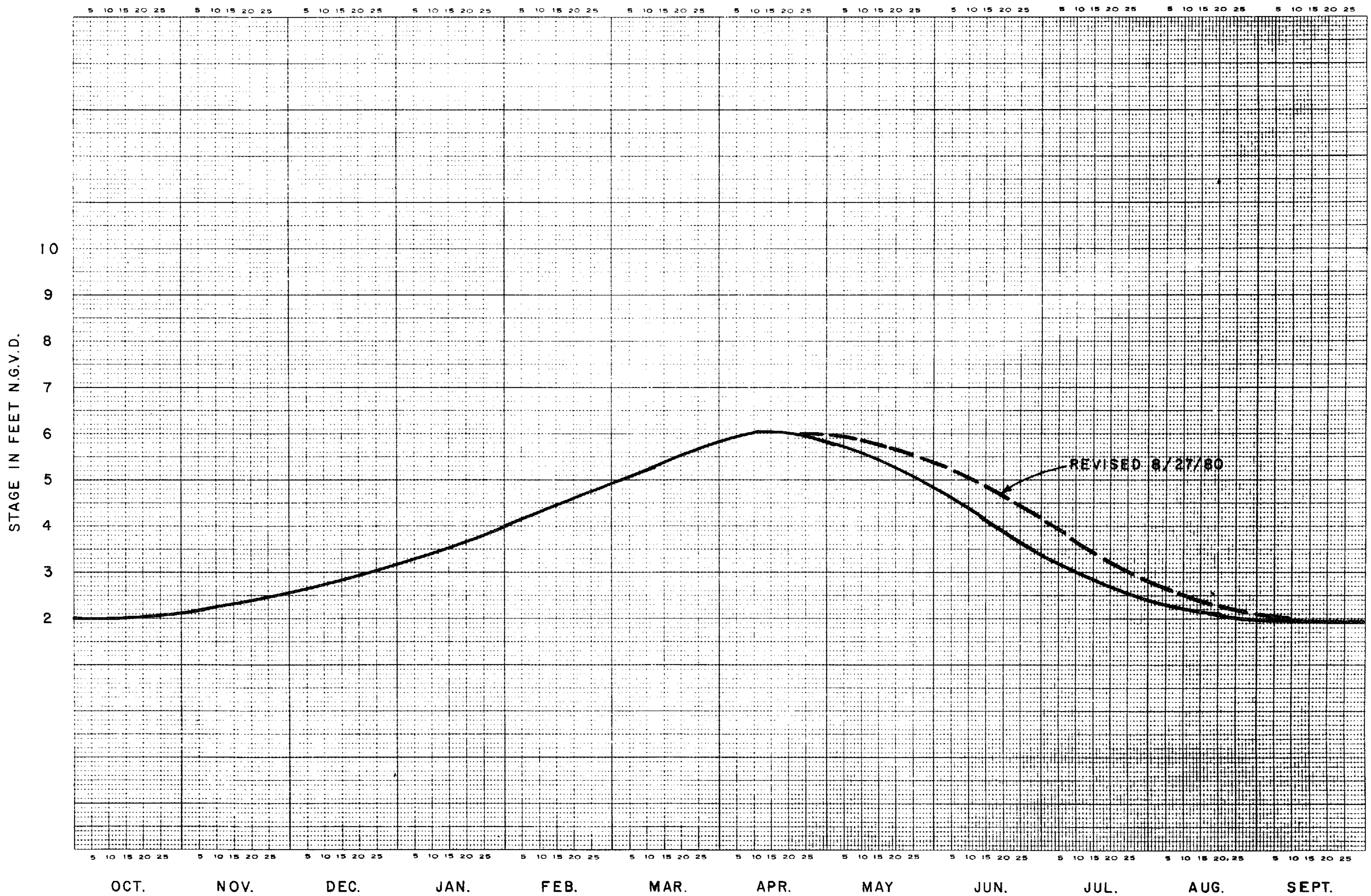


FIGURE G-6-15 PRESENT AND THEORETICAL DESIRED HYDROGRAPH FOR HENDERSON

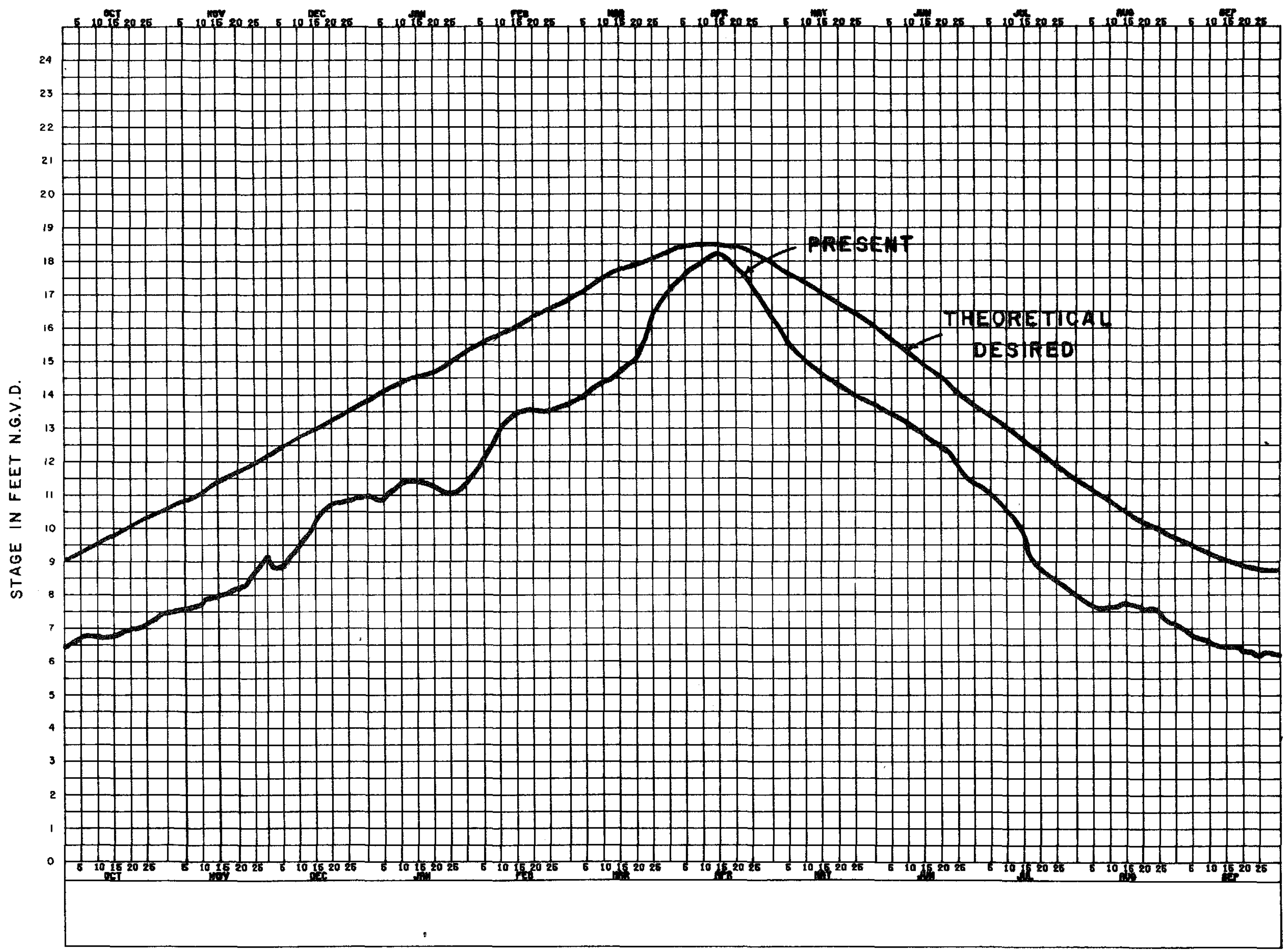


FIGURE G-6-16 PRESENT AND THEORETICAL DESIRED HYDROGRAPH FOR COCODRIE SWAMP

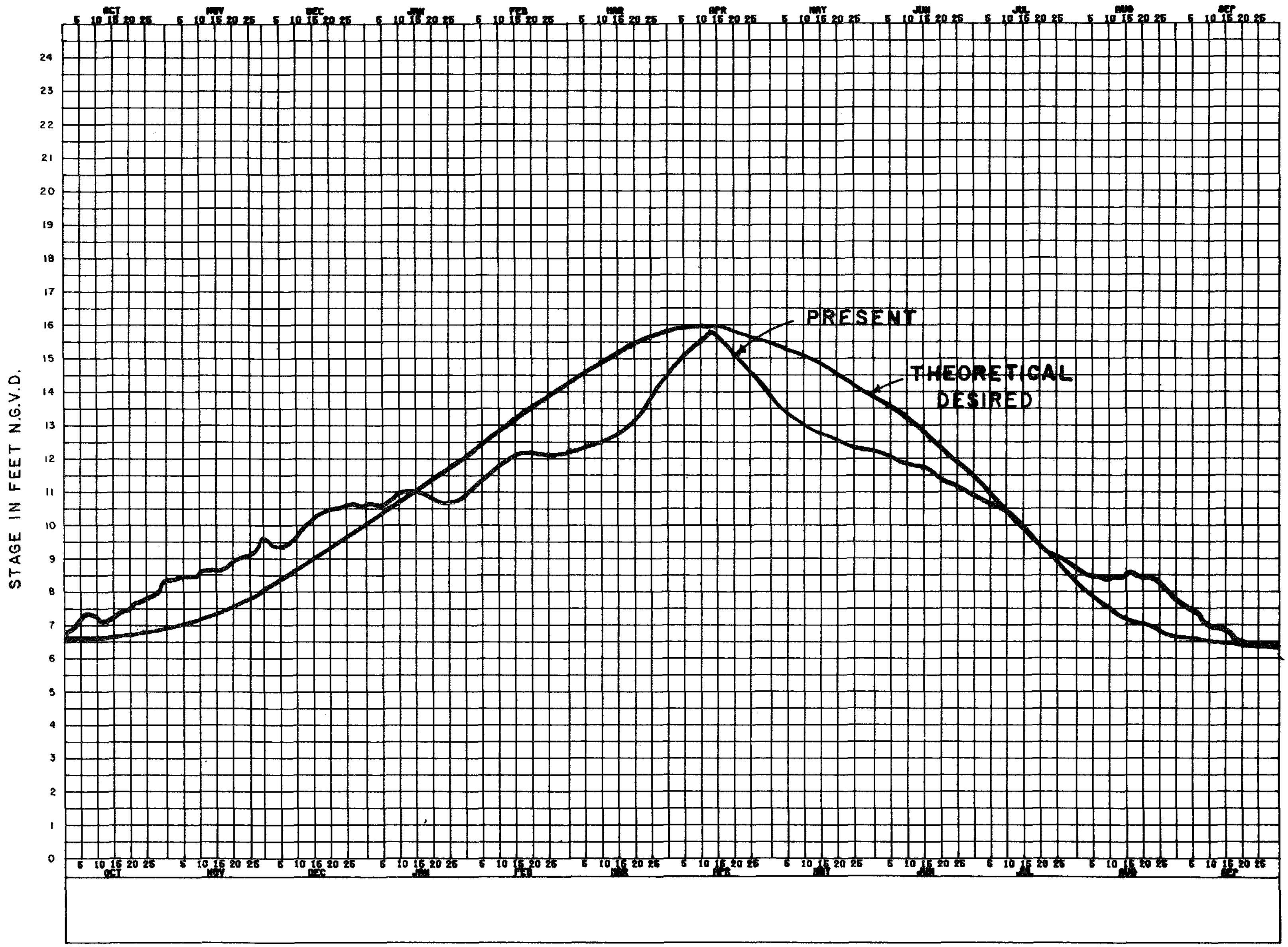


FIGURE G-6-17 PRESENT AND THEORETICAL DESIRED HYDROGRAPH FOR BEAU BAYOU

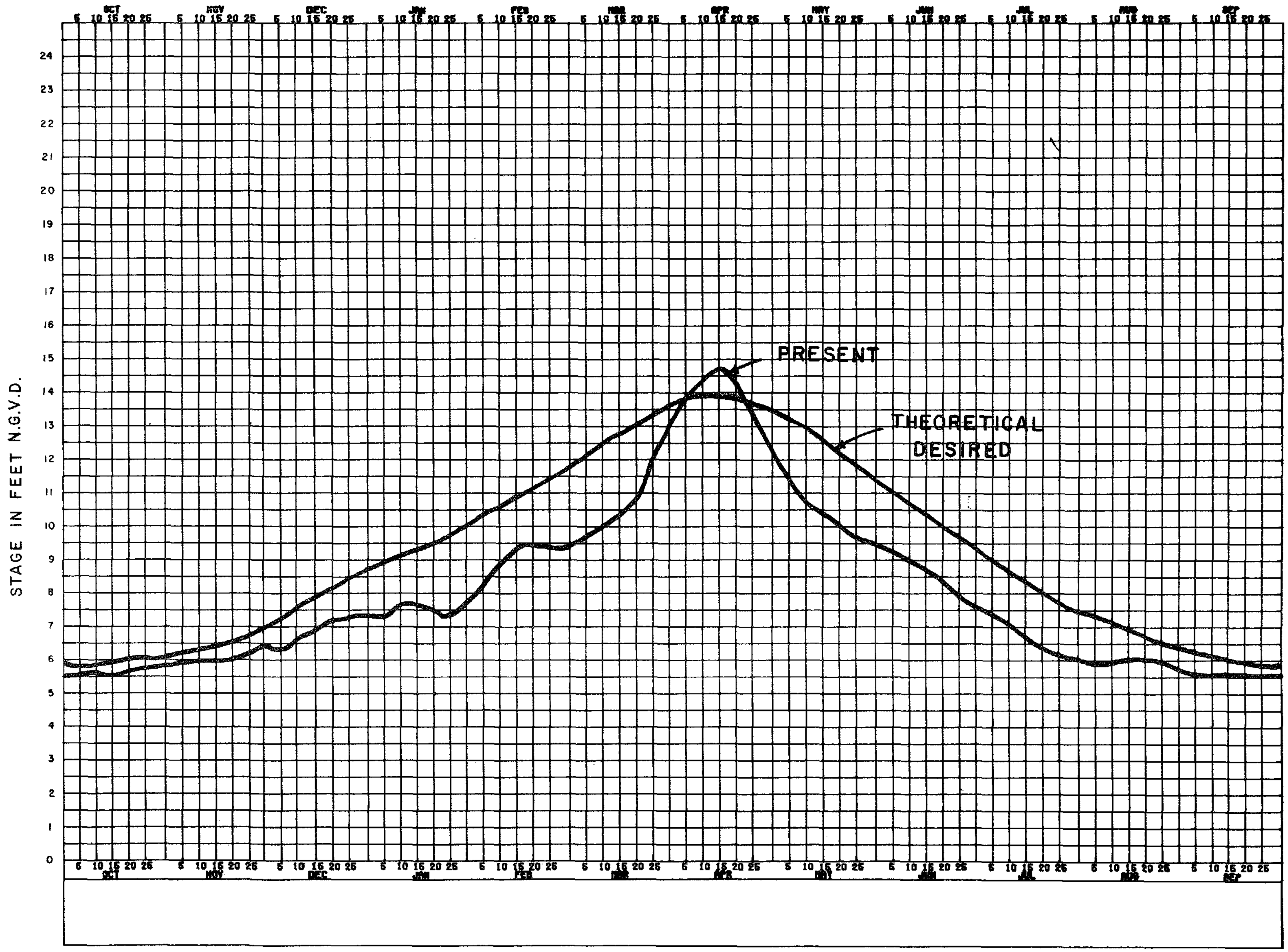


FIGURE G-6-18 THEORETICAL DESIRED HYDROGRAPH FOR BUFFALO COVE

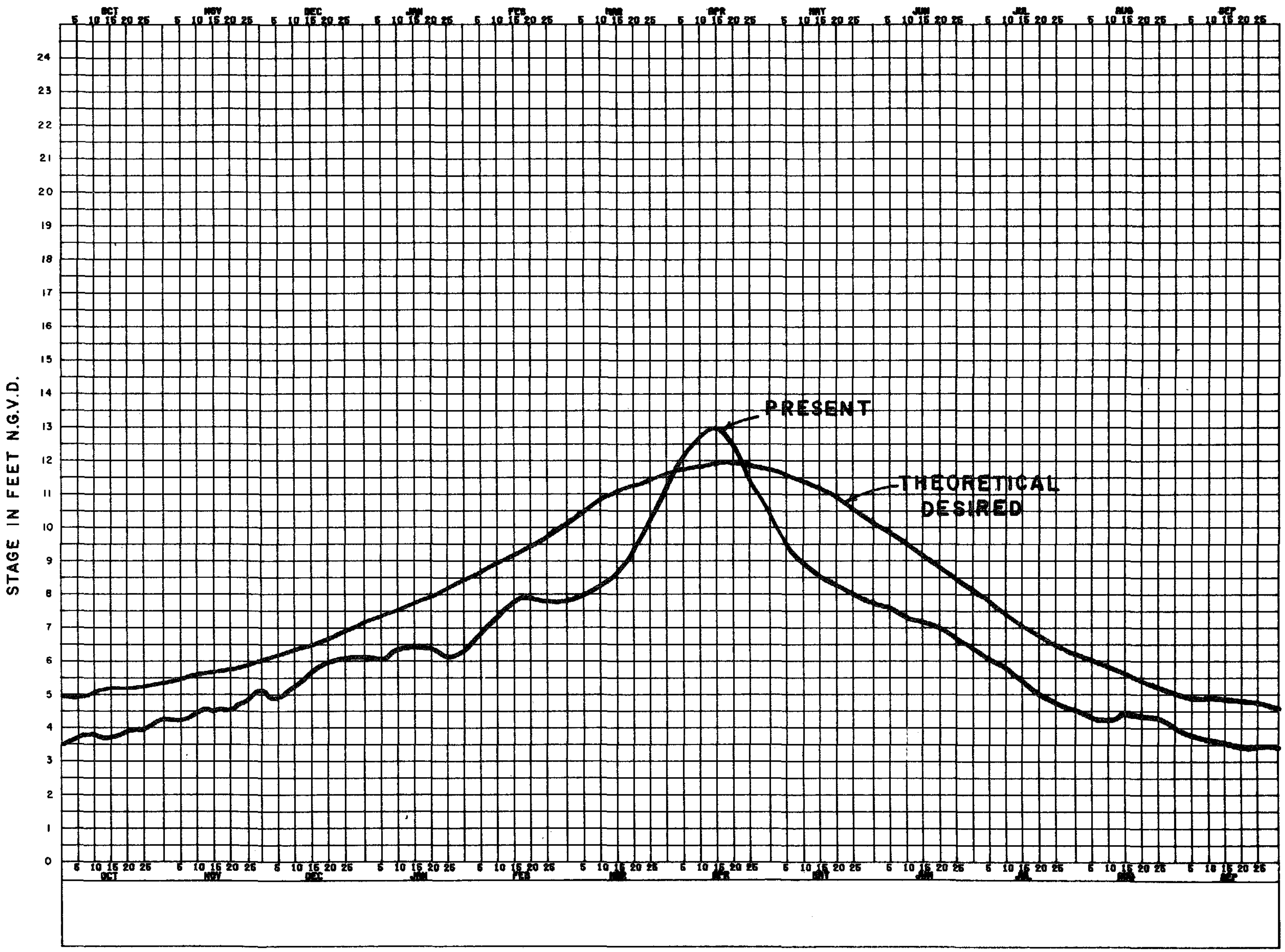


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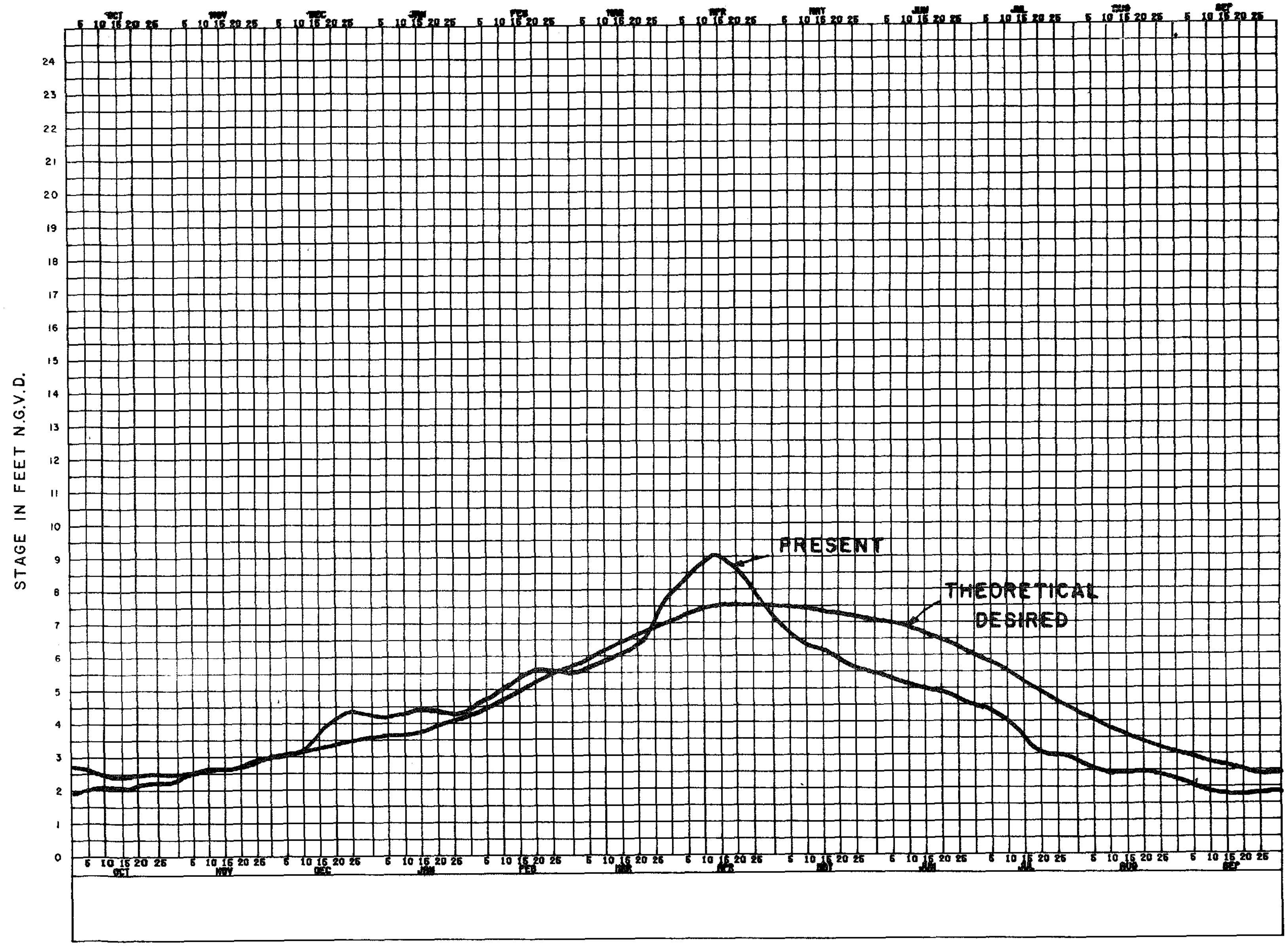
FIGURE G-6-19 PRESENT AND THEORETICAL DESIRED HYDROGRAPH FOR FLAT LAKE



Section 7 - COASTAL ZONE MANAGEMENT CONSISTENCY DETERMINATION

G.7.1. Since the State of Louisiana now has an approved Coastal Zone Management Act (The Louisiana State and Local Coastal Resources Management Act of 1978, La. R.S. 49:213.1, Act 361), any Federal agency proposing development in the coastal zone must determine if the development is consistent with state guidelines. The purpose of this appendix is to do just that. Consistency has been determined for the Recommended Plan only and not for operation and maintenance of existing features. Details of this plan are described in the Main Report/EIS and impacts are discussed in the EIS. It must be pointed out that the Corps is not making a recommendation on the Avoca Island levee at this time. Since the recommended plan contains numerous features, the consistency of each feature has been determined. Table G-7-1 summarizes each guideline and indicates the status of each feature in relation to each guideline. Wherever necessary, the consistency of a feature is discussed by guideline in subsequent paragraphs.

G.7.2. Guideline 1.7a - Channel training above Morgan City would reduce sediments carried into adjacent forested wetlands. This reduction would aid in preserving the wetlands. Channel training along the lower Atchafalaya River and Wax Lake Outlet would reduce the amount of riverborne sediments and nutrients that reach adjacent marshes; however, gaps left in the training works would allow some river overflow. At present, it appears that this channel training is probably one of the more feasible and practicable methods of causing a reduction in flowline. Changes in flows at the outlets would change the sediment distribution, but the total amount of sediment delivered to Atchafalaya Bay would not change. Thus, all these features are consistent with this guideline to the maximum extent practicable.

G.7.3. Guideline 1.7b - Channel training north of Morgan City, management units and work at the outlets, would both cause some adverse economic impacts by interruption of navigation. However, the environmental and/or other economic benefits of these features would outweigh this slight loss and thus, all features are consistent to the maximum extent practicable.

G.7.4. Guideline 1.7d - All features would cause a temporary and localized reduction in dissolved oxygen during construction. Management units, by reducing the amount of water flowing through them, could reduce dissolved oxygen levels from present levels.

TABLE G-7-1

CONSISTENCY WITH COASTAL ZONE MANAGEMENT GUIDELINES

		PLAN FEATURES							
		70/30	Levee Raising	Channel Training AR	Channel Training LAR	Sediment Reduction	Manage-ment Units	Outlets	Widen WLO Overbank
1.1	Guidelines must be read in their entirety.	Acknowledged							
1.2	Conformance with applicable water and air quality law is necessary.	Acknowledged							
1.3	General and specific guidelines are included. If inconsistent, specific apply.	Acknowledged							
1.4	Guidelines shall not consist in involuntary taking of property.	Acknowledged							
1.5	No use shall violate terms of a grant of or waterbottoms to the State.	Acknowledged							
1.6	Information regarding numerous general factors shall be utilized in evaluating compliance.	Acknowledged							
1.7a	Avoid reduction in sediment and nutrients.	C	C	C*	C**	C*	C	C*	C
1.7b	Avoid adverse economic effects.	C	C	C*	C	C	C*	C*	C
1.7c	Avoid detrimental discharge of inorganic nutrients.	C	C	C	C	C	C	C	C
1.7d	Avoid alternation of oxygen in water.	C	C*	C*	C*	C*	C*	C*	C*
1.7e	Avoid destruction of wetlands and water bodies.	C	C*	C*	C**	C*	C*	C*	C*
1.7f	Avoid disruption of existing social patterns.	C	C*	C*	C	C*	C*	C	C
1.7g	Avoid alteration of temperature.	C	C*	C*	C*	C*	C*	C*	C*
1.7h	Avoid detrimental change in salinity.	C	C	C	C	C	C	C	C
1.7i	Avoid detrimental changes in sediment transport.	C	C	C*	C**	C*	C	C	C
1.7j	Avoid adverse effect of cumulative impacts	C	C*	C*	C**	C*	C*	C*	C*

C = feature is consistent with the guideline to the maximum extent practicable.

C* = feature is consistent with guideline to maximum extent practicable and is discussed in accompanying text.

C** = some doubt exists whether this feature is consistent with the guideline to maximum extent practicable. Matter is discussed in text.

N/A = guideline does not apply to feature in question.

TABLE G-7-1

CONSISTENCY WITH COASTAL ZONE MANAGEMENT GUIDELINES

		PLAN FEATURES							
		70/30	Levee Raising	Channel Training AR	Channel Training LAR	Sediment Reduction	Manage-ment Units	Outlets	Widen WLO Overbank
1.7k	Avoid detrimental discharge of suspended solids.	C	C*	C*	C*	C*	C*	C*	C*
1.7l	Avoid blockage of natural circulation.	C	C	C*	C*	C*	C*	C*	C*
1.7m	Avoid discharge of pathogens or toxic substances.	C	C	C	C	C	C	C	C
1.7n	Avoid destruction or alteration of archeological or historical resources.	C	C*	C*	C*	C*	C*	C*	C*
1.7o	Avoid detrimental secondary effects.	C	C	C	C**	C	C	C	C
1.7p	Avoid adverse alteration of wildlife management areas.	C	C	C*	C	C	C*	C	C
1.7q	Avoid adverse alteration of parks and recreation areas, etc.	C	C	C	C	C	C	C	C
1.7r	Avoid disruptions of wildlife and fishery migratory patterns.	C	C	C*	C	C	C*	C	C
1.7s	Avoid land loss, erosion, and subsidence.	C	C	C	C**	C*	C	C	C
1.7t	Avoid increase in flood potential.	C*	C*	C*	C*	C*	C*	C*	C*
1.7u	Avoid reduction in long-term biological productivity.	C	C	C	C**	C*	C*	C	C*
1.8	If benefits clearly outweigh adverse impacts of non-compliance and there are no feasible alternatives, and significant public benefteis result, or the use would serve important interests, or is water dependent, the use will be in compliance.	Acknowledged							
1.9	Uses shall permit multiple concurrent uses and avoid unnecessary conflicts with other uses.	C*	C*	C*	C*	C*	C*	C*	C*
1.10	Guidelines shall not expand governmental authority.	Acknowledged							
2.1	Leveeing of biologically productive wetlands shall be avoided.	N/A	C*	N/A	N/A	N/A	C*	C*	C*

TABLE G-7-1

CONSISTENCY WITH COASTAL ZONE MANAGEMENT GUIDELINES

		PLAN FEATURES							
		70/30	Levee Raising	Channel Training AR	Channel Training LAR	Sediment Reduction	Manage-ment Units	Outlets	Widen WLO Overbank
2.2	Levees shall be sited to avoid segmentation of wetland systems.	N/A	C	N/A	N/A	N/A	C*	C*	C*
2.3	Levees for development shall be avoided.	N/A	C	N/A	N/A	N/A	C	C	C
2.4	Hurricane and flood protection levees should be at the wetland/non-wetland interface.	N/A	C*	N/A	N/A	N/A	C*	C*	C*
2.5	Impoundment levees only constructed as part approved water management project.	N/A	C	N/A	N/A	N/A	C*	C	C
2.6	Levees shall use best practicable techniques to minimize disruption of inter-change of organisms, nutrients, and water.	N/A	C	N/A	N/A	N/A	C	C	C
3.1	Linear facilities shall avoid areas of high biologic productivity.	N/A	N/A	C*	C**	N/A	N/A	N/A	N/A
3.2	Avoid use of dredging or filling to maximum extent practicable.	N/A	N/A	C*	C*	N/A	N/A	N/A	N/A
3.3	Facilities involving dredging shall be minimum length.	N/A	N/A	C*	C*	N/A	N/A	N/A	N/A
3.4	Pipelines should be installed by bush ditch method and backfilled.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3.5	Existing corridors should be utilized.	N/A	N/A	C*	C*	N/A	N/A	N/A	N/A
3.6	Linear facilities shall permit multiple use.	N/A	N/A	C*	C**	N/A	N/A	N/A	N/A
3.7	Linear facilities shall avoid barrier islands.	N/A	N/A	C	C	N/A	N/A	N/A	N/A
3.8	Linear facilities shall not traverse gulf shoreline.	N/A	N/A	C	C	N/A	N/A	N/A	N/A
3.9	Linear facilities should avoid disruption of hydrologic and sediment transport and minimize adverse impacts on wetlands.	N/A	N/A	C*	C**	N/A	N/A	N/A	N/A
3.10	Linear facilities should prevent bank erosion and saltwater intrusion.	N/A	N/A	C	C	N/A	N/A	N/A	N/A
3.11	Canals connecting areas of differing salinity shall be plugged.	N/A	N/A	C	C	N/A	N/A	N/A	N/A

TABLE G-7-1

CONSISTENCY WITH COASTAL ZONE MANAGEMENT GUIDELINES

		PLAN FEATURES							
		70/30	Levee Raising	Channel Training AR	Channel Training LAR	Sediment Reduction	Management Units	Outlets	Widen WLO Overbank
3.12	Multiple use and directional drilling shall be used for canals.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3.13	Pipeline construction codes.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3.14	Canals backfilled.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3.15	Sites revegetated.	N/A	N/A	C*	C*	N/A	N/A	N/A	N/A
3.16	Dead-end canals shall be avoided.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4.1	Spoil shall be disposed to avoid disruption of water movement, flow, circulation, and quality.	N/A	N/A	N/A	N/A	C*	N/A	N/A	C*
4.2	Spoil shall be used to improve environmental productivity or upland disposal areas shall be used.	N/A	N/A	N/A	N/A	C*	N/A	N/A	C*
4.3	Spoil shall not impound or drain wetlands.	N/A	N/A	N/A	N/A	C	N/A	C	C
4.4	Spoil shall not be disposed on marsh, reefs, or grass beds.	N/A	N/A	N/A	N/A	C	N/A	C	C*
4.5	Spoil shall not be disposed to hinder navigation, fishing, or timber growth.	N/A	N/A	N/A	N/A	C*	N/A	C	C
4.6	Spoil areas shall be designed to retain spoil at the site, reduce turbidity, and reduce erosion.	N/A	N/A	N/A	N/A	C	N/A	C	C
4.7	Alteration of state-owned property shall not occur without consultation with Department of Natural Resources.	N/A	N/A	N/A	N/A	C	N/A	C	N/A
5.1-5.9		No shoreline modifications are proposed.							
6.1	Industrial, commercial, urban, residential, and recreational uses shall be encouraged in suitable areas.	No such uses are proposed.							
6.2	Levees, roads, etc., shall be built only to protect areas suitable for development and when they are consistent with other guidelines and land use plans.	N/A	C*	C	C	C	C*	C*	C*
6.3	Deleted.	Acknowledged							
6.4	Wetland areas shall not be drained or filled. Property damage and adverse environmental impacts shall be minimized.	N/A	C*	C*	C*	C*	C*	C*	C*

TABLE G-7-1

CONSISTENCY WITH COASTAL ZONE MANAGEMENT GUIDELINES

		PLAN FEATURES							
		70/30	Levee Raising	Channel Training AR	Channel Training LAR	Sediment Reduction	Manage-ment Units	Outlets	Widen WLO Overbank
6.5	Coastal water dependent uses given special consideration.	Acknowledged							
6.6	Modified areas shall be returned to predevelopment condition after use.	N/A	C*	C*	C*	C*	C*	C*	C*
6.7	Site clearing shall be limited to immediate construction area.	N/A	C	C	C	C	C	C	C
6.8	Alterations shall be located away from critical wildlife and vegetation areas. ALterations in wildlife management areas shall be in accord with require-ments of wildlife management body.	N/A	C	C*	C	C	C*	C	C
6.9	Adverse impacts shall not occur on barrier islands, cheniers, natural levees, wildlife or fishery breeding or spawning areas or migratory routes.	N/A	C*	C*	C*	C*	C*	C*	C*
6.10	Creation of low dissolved oxygen or traps for heavy metals shall be avoided.	N/A	C*	C*	C*	C*	C*	C*	C*
6.11	Surface mining and shell dredging shall use best practicable techniques.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6.12	Creation of underwater obstructions shall be avoided.	N/A	C	C	C	C	C*	C	C
6.13	Release of pollutants and toxic susbstances shall be avoided.	N/A	C	C	C	C	C	C	C
6.14	Only contaminant-free material shall be used as fill	N/A	C	C	C	C	C	C	C
7.1	Controlled diversion of sediment-laden waters to create and nourish marsh shall be encouraged.	N/A	N/A	C*	C*	C*	C*	C*	N/A
7.2	Sediment deposition shall be part of an approved plan and offset land loss or create or restore wetlands.	N/A	N/A	C	C	C	C	C	N/A
7.3	Sediment shall not be deposited in sensitive habitat or navigation areas.	N/A	N/A	C*	C*	C	C	C	N/A
7.4	Diversion of freshwater through siphons to introduce nutrients shall be encouraged; includes a monitoring plan.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

TABLE G-7-1

CONSISTENCY WITH COASTAL ZONE MANAGEMENT GUIDELINES

		PLAN FEATURES							
		70/30	Levee Raising	Channel Training AR	Channel Training LAR	Sediment Reduction	Manage- ment Units	Outlets	Widen WLO Overbank
7.5	Water or marsh managment plans shall result in overall benefit to productivity.	N/A	N/A	N/A	N/A	N/A	C*	N/A	N/A
7.6	Water control structures shall be assessed separately on their own merits.	N/A	N/A	N/A	N/A	N/A	C	N/A	N/A
7.7	Weirs shall be designed to prevent "cut around".	N/A	N/A	N/A	N/A	N/A	C	C	N/A
7.8	Impoundments shall not be constructed in brackish or saline areas.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7.9	Withdrawal of water shall not result in saltwater intrusion.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8.1- 8.9	Waste disposal.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9.1	Upland water management programs shall preserve or enhance existing water quality volume and rate of flow.	C	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9.2	Runoff from developed areas shall simulate natural quantity, quality and rate of flow.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9.3	Runoff and erosion from agricultural lands shall be minimized.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.1- 10.14	Oil, gas and other mineral activities.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

However, oxygen levels in all probability, would be higher than under future conditions without management units. Thus, all features are considered to be consistent with this guideline to the maximum extent practicable.

G.7.5. Guideline 1.7e - Levee raising would destroy wetlands and water bodies, but the benefits gained would outweigh the loss of wetlands. There are no feasible and practicable alternatives to levee raising for flood protection. Channel training above Morgan City would also destroy wetlands, but it would also protect wetlands by preventing sedimentation. The wetlands saved and the flood protection gained by this feature would be significant public benefits. Channel training below Morgan City would destroy wetlands and water bodies. For a discussion of the benefits of this feature, see discussion of guideline 1.7a. Sediment reduction by distributary realinement would destroy wetlands, but would preserve more wetlands than it would destroy. Management units would destroy wetlands, but the benefits they would accrue to the aquatic ecosystem, by preserving water bodies, would outweigh the wetland destruction. Control of flow at the outlets would cause the destruction of some wetlands, but the increased outlet capacity realized by this feature would aid in flood control. Other diversions of outlet flow could be constructed, but all would involve a weir and levee, so construction of these features is the only practicable method of increasing the outlet capacity. Widening of Wax Lake Outlet overbank would destroy wetlands, but would also reconnect 7,800 acres of wetlands to the riverine and tidal systems. Thus, all the above features are considered to be consistent with this guideline to the maximum extent practicable.

G.7.6. Guideline 1.7f - Channel training in the main channel above Morgan City would disrupt boat traffic toward Duck Lake and toward the south also. Construction of managment units would make access difficult, since only the inlets and outlets could be used by crew boats and larger recreational craft. Small boats could utilize rollovers unless loaded with crawfish. However, the management units would preserve aquatic habitat longer than the without condition. Levee raising and sediment reduction would both displace camps, which would disrupt social patterns. However, the flood control benefits would outweigh these adverse social impacts. All features are considered to be consistent to the maximum extent practicable.

G.7.7. Guideline 1.7g - All features that increase turbidity would slightly raise water temperatures, but this effect would be local and temporary but features would be in compliance with the guideline. Increasing the amount of cold river water entering the eastern portion of Atchafalaya Bay would slightly lower the temperature, but the effect should not be significant. All features are considered to be consistent with this guidline to the maximum extent practicable.

G.7.8. Guideline 1.7h - The possible future change in outlet percentages would slightly freshen Atchafalaya Bay and make East Cote

Blanche Bay somewhat more brackish. This change should not be detrimental; therefore, the feature is in compliance.

G.7.9. Guideline 1.7i - Channel training and sediment reduction would prevent sediment deposition in the floodway and marshes, thereby providing more sediment to the littoral transport system than there is now. These features are considered to be in compliance with guideline 1.7i to the maximum extent practicable.

G.7.10. Guideline 1.7j - All features would add to cumulative adverse environmental impacts already occurring in the coastal zone. Channel training in the Atchafalaya River, sediment reduction, widening Wax Lake Outlet overbank, and management units would all destroy wetlands, but would have beneficial environmental impacts, such as reducing sedimentation in wetlands or preserving the aquatic ecosystem. Levee raising and control of the outlets would add to cumulative impacts, but are a necessary part of the flood control plan with substantial social benefits. The benefits of channel training in the lower river are described under guideline 1.7a. Thus, it is felt that all features comply with guideline 1.7j to the maximum extent practicable.

G.7.11. Guideline 1.7k - All features would cause a temporary and localized discharge of suspended solids into the coastal system during construction. Turbidity would occur only in the vicinity of the work and would be short-lived. All features comply with this guideline to the maximum extent practicable.

G.7.12. Guideline 1.7l - Channel training above Morgan City would block natural circulation, but also reduce overbank sedimentation into wetlands and lower the flood flowline. Channel training below Morgan City would do the same, but the lost sediment would have nourished the marshes. Distributary realinement would slightly change circulation patterns and produce environmental benefits. Management unit construction would seal off some natural and man-made canals in order to preserve the aquatic ecosystem within the unit. Construction of a weir and levee at the outlets would block circulation, but provide additional channel capacity at the outlets. The levee constructed adjacent to the Bayou Sale ridge during widening of Wax Lake Outlet would prevent natural runoff into the swamp from the ridge. However, degradation of the existing levees along the west side of Wax Lake Outlet would add 7,800 acres to the riverine and tidal systems. Thus, these features are consistent with this guideline to the maximum extent practicable.

G.7.13. Guideline 1.7n - Only the levee raising feature of the tentatively selected plan has been subject to an intensive cultural resources survey. The survey located National Register eligible site 16SM45 and 11 additional cultural resources possibly eligible for inclusion in the National Register in the project corridor. The effects of the levee enlargement feature of this plan upon each of these significant cultural resources is currently being determined. Cultural resources surveys of all other project features will be completed prior to construction and any Register or Register-eligible properties will be avoided, protected, or, in the absence of a feasible alternative, mitigated by data recovery. Thus, all features are consistent to the maximum extent practicable.

G.7.14. Guideline 1.7o - The channel training below Morgan City could reduce input of riverborne sediments into marshes which could increase the loss rate of these lands. The adverse secondary impact would probably be outweighed by the beneficial impacts described under guideline 1.7a.

G.7.15. Guideline 1.7p - Channel training above Morgan City would alter portions of the Attakapas Wildlife Management Area from river miles 90 to 95. This feature would preserve wetlands in the same area and lower the flood flowline. Thus, it is considered consistent with guideline 1.7p to maximum extent practicable. Management units would hinder boat access into the Buffalo Cover portion of this management area. However, units would preserve aquatic habitat in the area and are therefore considered to be consistent to the maximum extent practicable.

G.7.16. Guideline 1.7r - Channel training above Morgan City could disrupt migratory patterns of amadromous and catadromous fishes, but the 17-mile restriction should not cause severe problems. Management units would also disrupt migratory patterns of such fish by closing numerous bayous and canals. The benefits these units would have to the aquatic system should far outweigh the adverse impacts. Thus, these features are considered to be consistent with this guideline to the maximum extent practicable.

G.7.17. Guideline 1.7s - Distributary realinement would increase the amount of sediment available for delta building in Atchafalaya Bay and is considered consistent with this guideline to the maximum extent practicable. Channel training below Morgan City would reduce riverborne sediment introduction into adjacent marshes, which would increase the land loss rate in these marshes. The benefits of this feature are discussed under guideline 1.7a.

G.7.18. Guideline 1.7t - All features would decrease the potential of flooding and are consistent with this guideline to the maximum extent practicable.

G.7.19. Guideline 1.7u - Sediment reduction, management units, and widening Wax Lake Outlet overbank would all increase long-term aquatic biological productivity of the coastal ecosystem and therefore are consistent with this guideline.

G.7.20. Guideline 1.9 - In general, multiple concurrent uses are not practicable with the exception that the raised levees serve as roads in certain places. All features are considered in compliance with this guideline to the maximum extent practicable.

G.7.21. Guideline 2.1 - The raising of the protection levees would not inclose any wetlands, but would destroy wetlands during construction. However, the flood control benefits would outweigh the adverse impacts of wetland loss as described under guideline 1.7e. Management units would basically levee wetlands, but this leveeing would increase aquatic productivity over future without-project conditions. The levee built to control flow at the outlets would not impound wetlands, nor would the levee along the widened Wax Lake Outlet. Benefits are discussed under guideline 1.7e. Hence, these features are consistent with this guideline to the maximum extent practicable.

G.7.22. Guideline 2.2 - Management units would complete the segmentation of wetland areas that are nearly segmented at the present time. The levee for outlet control would not segment wetland areas. The levee for widening Wax Lake Outlet would not significantly segment wetland areas, since it will be located near the wetland/ridge interface. Thus, all these features are consistent with guideline 2.2.

G.7.23. Guideline 2.3 - Most of the levees in this project would not be built for the purpose of developing or otherwise changing the use of wetlands; therefore, these features are consistent with this guideline.

G.7.24. Guideline 2.4 - The raising of the protection levees would be at the wetland/non-wetland interface. The few levees necessary to complete the segmentation of management units would also be at the water/land interface. The levee to control flow at the outlets would be along the riverbank, which is basically a wetland/non-wetland interface. The levee along the widened Wax Lake Outlet overbank would be near the interface. All these levees are consistent with guideline 2.4 to the maximum extent practicable.

G.7.25. Guideline 2.5 - Levees completing the encirclement of management units are the only impoundment levees proposed in this project. The management units are a vital part of a water management plan that would help preserve the aquatic ecosystem. Thus, this feature is considered consistent with this guideline to the maximum extent practicable.

G.7.26. Guideline 3.1 - For purposes of this consistency determination, the channel training works are considered linear facilities. Channel training above Morgan City would destroy some forested wetlands but would protect additional acres from sedimentation. Thus, it is consistent with this guideline to the maximum extent practicable. Channel training below Morgan City would destroy marsh directly and increase land loss in adjacent marsh. The benefits of this feature are discussed under guideline 1.7a.

G.7.27. Guideline 3.2 - Channel training above Morgan City utilizes dredged material, but gains environmental benefits. Channel training below Morgan City does attempt to avoid deposition of dredged material in wetland by leaving gaps in the training works. These features are consistent with this guideline to the maximum extent practicable.

G.7.28. Guideline 3.3 - The channel training works are of the minimum practical length and are consistent with this guideline to the maximum extent practicable.

G.7.29. Guideline 3.5 - The existing riverbank would be utilized for these channel training work; thus, both features are consistent with the guideline to the maximum extent practicable.

G.7.30. Guideline 3.6 - Channel training above Morgan City would "share" 5 miles of levee with the outlet control feature; therefore, it is consistent with the guideline to the maximum extent practicable. Channel training below Morgan City has no multiple use; its benefits are described under guideline 1.7a.

G.7.31. Guideline 3.9 - Channel training would disrupt overflow and sediment transport to adjacent wetlands. Works above Morgan City would preserve forested wetlands by sediment reduction and therefore are consistent with this guideline to the maximum extent practicable. Works below Morgan City would not have similar beneficial environmental effects; their flood benefits are described under guideline 1.7a.

G.7.32. Guideline 3.15 - The channel training works would revegetate naturally with early successional bottomland hardwoods in one to two growing seasons. The features are consistent with this guideline to the maximum extent practicable.

G.7.33. Guideline 4.1 - This series of guidelines would apply to the distributary realinement feature, where some dredged material would be disposed on land near the Old Atchafalaya River and most would be deposited in the main channel. The disruption to water flow circulation and quality caused by this feature would be minor. Water quality would be temporarily lowered by construction turbidity, but water quality within swamps would be improved by sediment reduction. Thus, this feature is consistent with guideline 4.1 to the maximum extent practicable. This series also would apply to material created by degradation of the existing Wax Lake Outlet overbank levees. The material would be either hauled to build the new levee or utilized to backfill the borrow pit. In neither case would it disrupt water circulation and it is therefore consistent with this guideline to the maximum extent practicable.

G.7.34. Guideline 4.2 - An upland disposal area would be used at Old Atchafalaya River. The levee material utilized to backfill the borrow pit at Wax Lake Outlet would create marsh. The remainder would be utilized for upland disposal. Thus, these features are consistent with this guideline to the maximum extent practicable.

G.7.35. Guideline 4.4 - A small amount of marsh would be destroyed by widening the Wax Lake Outlet overbank area. The beneficial impacts of this feature would outweigh this adverse impact; and thus, this feature is considered consistent to the maximum extent practicable.

G.7.36. Guideline 4.5 - When land disposal is utilized at Old Atchafalaya River and Wax Lake Outlet overbank, some trees may be destroyed and growth of others hindered. However, the environmental benefits realized by these features would far outweigh the losses. Thus, these features are considered to be consistent to the maximum extent practicable.

G.7.37. Guideline 6.2 - The raising of the protection levees would protect areas already protected. Levees necessary for management units would attempt to preserve the aquatic ecosystem within the units. The levees at the outlets and at widened Wax Lake Outlet overbank would increase outlet capacity and have desirable environmental benefits. Thus, these features are consistent with this guideline to the maximum extent practicable.

G.7.38. Guideline 6.4 - Levee raising, channel training, sediment reduction, management units, the levee at the outlets, and the levee along the widened Wax Lake Outlet overbank are all in wetlands but, as discussed under guideline 1.7e, social benefits would be substantial, making these features consistent with this guideline to the maximum extent practicable.

G.7.39. Guideline 6.6 - The levees necessary to complete the management units channel training works, and distributary closures would revegetate with early successional forest. The raised protection levees, the levees controlling the outlets, and the levees at the widened Wax Lake Outlet overbank would be in use for the life of the project and could not be returned to predevelopment condition. Thus, all features are consistent with this guideline to the maximum extent practicable.

G.7.40. Guideline 6.8 - The levees completing the Buffalo Cove management unit would disrupt access into Attakapas Wildlife Management Area. However, the management unit would help maintain fishery productivity in the management area. Channel training above Morgan City would alter a small portion of the Attakapas Wildlife environmental benefits would outweigh the loss. These features are believed to be in compliance with the guideline to the maximum extent practicable.

G.7.41. Guideline 6.9 - Levee raising of protection levees, channel training works, distributary realinement, management unit levees, outlet levees, and the levee along the widened Wax Lake Outlet would all destroy wetlands, the breeding and spawning areas for fish, shellfish, waterfowl, etc. But, all of these features are consistent with this guideline to the maximum extent practicable, either because they have substantial flood control benefits or because they preserve environmental values.

G.7.42. Guideline 6.10 - Construction of all the features would cause a temporary localized reduction in dissolved oxygen. All features are considered consistent with this guideline to the maximum extent practicable.

G.7.43. Guideline 6.12 - The weirs at the inlets and outlets of management units would create underwater obstructions. However, the beneficial impacts of the units should far outweigh the inconvenience caused by the obstruction.

G.7.44. Guideline 7.1 - Channel training above Morgan City, sediment reduction, and management units would reduce the amount of sediment deposited in swamps, and bottomland hardwood and forests would increase the amount of sediment available for delta development and marsh nourishment. The outlet control weir would slightly reduce the amount of sediment passing from Wax Lake Outlet but would not change the total amount reaching Atchafalaya Bay. All features are considered consistent with this guideline to the maximum extent practicable.

G.7.45. Guideline 7.3 - The channel training works would shunt sediment down the Lower Atchafalaya River and slightly increase the amount of sediment in the Chene, Boeuf, and Black navigation channel. The beneficial flood control impacts of training works and environmental impacts of the training above Morgan City outweigh this; therefore, these features are considered to be consistent with this guideline to the maximum extent practicable.

G.7.46. Guideline 7.5 - The water management plans associated with management units would benefit aquatic productivity but would decrease terrestrial productivity (see Section 6 of EIS). This feature is consistent with this guideline to the maximum extent practicable.

G.7.47. In general, most features are consistent with these guidelines. The channel training works below Morgan City are in questionable compliance with guidelines 1.7a, 1.7e, 1.7i, 1.7j, 1.7s, 3.1, 3.6, and 3.9. Prior to selection of the final plans, a more detailed trade-off analysis will be conducted to determine if environmental and economic benefits of the channel training are worth the environmental impacts that they would cause. At present, it appers that this channel training is the most feasible and practicable method to reduce the flowline. Thus, this feature is considered to be minimally consistent with these guidelines to the maximum extent practicable.

Section 8 - MARSH ACREAGE CALCULATIONS WITH AND WITHOUT PROJECT

INTRODUCTION

G.8.1. The future without-project marsh acreage calculations and estimates of marsh loss that would be caused by the Avoca Island levee extension that were utilized in the draft EIS were generally those presented by the US Fish and Wildlife Service in their Planning Aid Report. Their calculations were based on preliminary data from Wicker (1980) and Bauman and Adams (1981). Because of a change in the length of levee reaches recommended subsequent to their report and because the impacts of Reach 1 alone had never been calculated, the Corps made some independent calculations for the draft EIS based on the US Fish and Wildlife methodology. In the months since publication of the draft EIS, some preliminary raw data from Wicker became available and we have utilized this data to recalculate marsh loss with and without the project.

FUTURE WITHOUT-PROJECT

G.8.2. A basic assumption in estimating the future without-project marsh loss was that sediment transport to the western Terrebonne Parish marshes would be reduced naturally as the delta developed in Atchafalaya Bay. The mouths of numerous distributaries such as Deer Island, Plumb, Palmetto and Carencro Bayous would become progressively reduced in cross-section so the bayous would carry less and less sediment into the marshes.

G.8.3. Fresh marsh. The fresh marsh in Hydrologic Unit V was divided into two areas based on loss rates calculated from Wicker's data. The western fresh zone receives sediment directly from the Atchafalaya River via the numerous bayous that transect it and via overbank flow. Wicker's data shows marsh loss rates varying from -0.30 to -0.60 percent per year during the period 1956-1978. However, Bauman and Adams showed that the area covered by Plumb Bayou and Carencro Bayou quadrangles had actually gained land in the 1972-1978 period. Thus, the assumption was made that the present loss rate for the former quad area would be -0.20 percent per year and not -0.30 percent per year as indicated by Wicker's data alone. The loss rate in the latter quad area was accordingly reduced from Wicker's -0.60 percent per year to -0.45 percent per year. The present marsh loss rate in the entire western zone was determined by estimating what percentage each quad contributed to the total zone and then multiplying that percentage by the annual loss in that quad and then adding the totals as shown below.

Morgan City SW	21 percent of area x 0.26 percent loss = 0.005
Plumb Bayou	34 percent of area x 0.20 percent loss = 0.068
Carencro Bayou	45 percent of area x 0.45 percent loss = 0.203
Loss rate in entire zone	= 0.326 percent per year

The eastern zone consists of the remainder of the fresh marsh area and receives little sediment input; thus, present loss rates vary from -0.40 percent per year to -1.35 percent per year. The present loss rate in the total eastern zone was calculated in the manner described above and was determined to be -0.96 percent per year.

G.8.4. The approximation was made that Atchafalaya Bay would be filled by the developing delta by sometime between 2010 and 2020. Rough assumptions of delta growth by decade were postulated. By approximately the year 2000, the western fresh marsh zone could be receiving a vastly reduced amount of sediment via distributary flow. Thus, one could assume that loss in the Plumb and Carencro Bayou quads could revert to that shown by Wicker's figures: -0.3 percent per year and -0.6 percent per year, respectively. When the loss in the total western zone is calculated using these figures the rate rises from the present -0.33 percent to -0.43 percent per year. As ensuing years pass, it was assumed that distributary flows would be reduced even more and western zone loss rates were assumed to increase by -0.10 percent each decade. By the 2020-2030 decade the loss rate was estimated to be -0.63 percent per year. The eastern zone was assumed to be unaffected by the developing delta and its loss rate was assumed to stay constant at -0.96 percent per yer.

G.8.5. The fresh marsh in Hydrologic Unit VI was calculated to have a loss rate of -0.48 percent at the present. As the percentage of flows going out the Wax Lake Outlet increased over the next 50 years, it was assumed that more sediment would be delivered to the Lake Salve quad and that between 2010 and 2030 the loss rate in Unit VI would decrease to -0.42 percent per year.

G.8.6. The only available data in Hydrologic Unit VII was for the Belle Isle quad which showed a loss rate of -0.02 percent per year.

The Belle Isle area received direct overflow from the Wax Lake Outlet while the remainder of the unit lies west of the Bayou Sale ridge. Over the next 50 years the loss rate in the Belle Isle quad would probably decrease while that of the western portion would increase slightly. Thus, it was assumed that the -0.02 percent per year loss rate would apply for the entire Unit from 1980 to 2030.

G.8.7. Table G-8-1 shows the estimated loss rate and the acreage in each marsh zone by hydrologic unit and by decade. During the period from 1980 to 2000, an unquantifiable amount of brackish marsh in the area covered by the Four League Bay and Plumb Bayou quads could become fresh as the freshwater bulb moves eastward. However, once the mouth of Four League Bay became constricted, this marsh could revert to brackish. Between 2000 and 2030 an unquantifiable amount of fresh marsh could become brackish as the percentage of flows between the Wax Lake Outlet and the Lower Atchafalaya River stabilizes at 50/50. Also, as subsidence occurs in the eastern zone, an unknown amount could become brackish. Because of the uncertainty of occurrence, none of these possibilities were considered in formulating Table G-8-1.

G.8.8. Brackish marsh. Brackish marshes were divided into a western zone that receives sediment via distributary flow and overbank flow from the Atchafalaya River and an eastern zone that is unaffected by the river. The marsh loss rate in the western zone was calculated to be -0.37 percent per year. Bauman and Adams found that the Four League Bay quad area gained in land between 1972 and 1978. Thus, it was assumed that the -0.42 percent annual loss calculated from Wicker's data for 1956-1978 would be reduced to -0.25 percent at the present. By approximately 2000, the sediment flows into Four League Bay could be reduced and the loss rate in the western zone could increase to -0.50 percent per year from 2000 to 2010. If it were assumed this loss rate would continue to increase as sediments transport decreased, the 2010-2030 loss rate would be -0.61 percent per year. It was assumed that the present rate in the eastern zone, -0.95 percent per year, would remain the same from 1980 to 2030. See Table G-8-1 for acreages. In the eastern zone, an unquantifiable amount of brackish marsh could become saline as subsidence increases. In the western zone, an unknown amount of saline marsh could become brackish during the next 25 years, but would revert to saline eventually.

G.8.9. Saline marsh. The western zone includes the area covered by the Oyster Bayou and East Bay Junop quads which are near the gulf. The marsh receives some sediment nourishment due to river and tidal transport. The overall loss rate is -0.43 percent per year. The eastern zone has a larger percentage of its area removed from the gulf and river influence and the loss rate is -1.11 percent per year. Since the delta would have little influence on the saline zone, it was assumed that these loss rates would remain the same for the 1980-2030 period. Thus, it was possible to calculate the loss rate for the entire saline zone to be -0.87 percent per year.

TABLE G-8-1

MARSH LOSS RATE AND ACREAGE BY DECADE FOR THE FUTURE WITHOUT-PROJECT CONDITION

	UNIT V										UNIT VI		UNIT VII	
	Western Fresh		Eastern Fresh		Western Brackish		Eastern Brackish		Saline		Fresh		Fresh	
Years	loss[1/] rate	acres	loss rate	acres	loss rate	acres	loss rate	acres	loss rate	acres	loss rate	acres	loss rate	acres
1980	0.33	96,033	0.96	126,822	0.37	57,216	0.95	31,810	0.87	107,337	0.48	47,992	0.02	50,581
1990	0.33	92,911	0.96	115,160	0.37	55,134	0.95	28,914	0.87	98,356	0.48	45,737	0.02	50,480
2000	0.43	89,890	0.96	104,570	0.50	53,128	0.95	26,282	0.87	90,126	0.48	43,589	0.02	50,379
2010	0.53	86,099	0.96	94,954	0.61	50,531	0.95	23,889	0.87	82,585	0.42	41,541	0.02	50,278
2020	0.63	81,643	0.96	86,223	0.61	47,532	0.95	21,714	0.87	75,675	0.42	39,829	0.02	50,178
2030	-	76,643	-	78,293	-	44,711	-	19,737	-	69,343	-	38,187	-	50,077

[1/] Loss rate in percent per year. This rate applies to subsequent decade.

G.8.10. Nonmarsh habitats. By utilizing Wicker's raw data sheets and overlaying the 1956 and 1978 US Fish and Wildlife Service habitat maps, it is possible to calculate not only marsh loss by quadrangle, but to estimate what habitat type these marsh acres became. Then one could take the weighted percentage loss per year by quad and calculate what percentage that is of the total zone loss. This percentage, when multiplied by the acres lost by zone per decade, gives the acres lost per quad area by decade. The percentage of the lost marsh by quad area that each nonmarsh habitat type gains is calculated next. This percentage is applied to the marsh loss by quad and the acreage increase in nonmarsh habitat types by decade is the result (see Table G-8-2).

IMPACTS OF THE AVOCA ISLAND LEVEE EXTENSION

G.8.11. As discussed in the Main Report/EIS, no recommendation will be made at this time for implementing the Avoca Island levee extension. However, the first reach of the levee extension was left in the NED plan because it would be the least costly method of flood protection. Thus, it was necessary to calculate the impacts of Reach 1 and to also calculate the impacts of the entire channel alinement levee extension. The latter was necessary because we have no accurate way to compare plans if we do not assume that continued levee extension would prevent rising water levels in the backwater area.

G.8.12. Fresh marsh. The eastern fresh marsh and marshes in Hydrologic Units VI and VII would not be affected by the levee extension. In the western zone, Reach 1 would not block Deer Island Bayou, and the Avoca Island Cutoff would still exist, though lengthened. The water diversion structure would introduce some sediment into the area covered by the Morgan City SW quad, but overall sediment transport would be reduced. Sheet flow to the Plumb Bayou quad area would be decreased and thus the loss rate in this western zone could rise from the present -0.35 percent to -0.36 percent per year in 1988 when Reach 1 would be built. If one makes the assumption that only Reach 1 would be built, then the loss due to this reach alone can be somewhat inaccurately calculated by assuming that after 2000 the loss rates in the western fresh zone would be similar to future without-project conditions. If one does this, the fresh marsh loss caused by Reach 1 alone would be approximately 900 acres. In order to accurately compare plans one must assume the entire levee would be built. Reach 2 in 1993 could further reduce sediment transport because the levee would block Deer Island Bayou and part of Crooked Bayou. Thus, the loss rate in the western zone could increase to -0.43 percent per year for the 1993-2000 period. Reach 3 in 2003 would nearly completely remove the western zone from distributary flows and the loss rate could increase to -0.56 percent per year from 2003 to 2010. Reach 4 in 2014 could slightly reduce sediment transport into

TABLE G-8-2

ACRES OF MARSH LOST AND NONMARSH HABITAT GAINED FOR THE FUTURE WITHOUT PROJECT CONDITION

Decade and Marsh Type	Marsh Acres Lost	ACRES OF NEW HABITAT CREATED								
		Lakes	Bayous	Spoil	Shrub	Cypress-Tupelo	Open Land	Riverine	Mangrove	Other
1980-1990										
Fresh	17,240	12,120	1,029	1,287	1,041	890	419	235		119
Brackish	4,978	4,138	348	228	111	60			35	52
Saline	8,981	8,162	302	280	81	60			94	
1990-2000										
Fresh	15,860	11,121	972	1,217	965	849	399	226		111
Brackish	4,638	3,851	331	215	102	55			34	50
Saline	8,230	7,482	275	256	76	66			86	
2000-2010										
Fresh	15,556	10,703	1,086	1,309	935	825	380	200		116
Brackish	4,990	4,069	281	267	88	56			45	53
Saline	7,580	6,889	385	236	70	51			79	
2010-2020										
Fresh	14,999	10,233	1,176	1,368	876	709	318	200		117
Brackish	5,174	4,180	455	284	79	53			53	61
Saline	6,910	6,278	231	215	64	46			72	
2020-2030										
Fresh	14,673	9,805	1,277	1,435	839	692	305	200		120
Brackish	4,786	3,871	425	265	72	49			47	57
Saline	6,330	5,754	212	197	59	42			66	

the western fresh zone and the loss rate could increase to -0.63 percent per year as this zone becomes further from the sediment source. Reaches 5 and 6 would probably only slightly reduce loss rates in the fresh zone to -0.69 percent per year. Table G-8-3 shows loss rates and acreage by target years. It was assumed that enough freshwater would be transported across the levee to maintain future without-project isohalines.

G.8.13. Brackish marsh. Loss rates in the eastern zone would be unaffected by the levee extension. Until completion of Reach 3 in 2003, loss rates in the western zone would be similar to those without the project. Reach 3 would prevent some sediment from reaching this zone and the loss rate would increase to -0.52 percent per year until 2010 when there would be a loss increase similar to that in the future without-project condition and the rate would be -0.63 percent per year until 2014. Reach 4 in that year would further decrease flows to Four League Bay and increase the loss rate to -0.73 percent per year. Reach 5 in 2024 would similarly increase the loss rate to -0.84 percent per year by reducing sediment transport into this zone.

G.8.14. Saline marsh. Saline marsh would be unaffected by the levee extension until construction of Reach 4 in 2014 slightly reduced the sediment transport through Four League Bay which would increase the loss rate to -0.88 percent per year. Reaches 5 and 6 would increase the loss rate to -0.89 percent per year.

G.8.15. Delta. In order to calculate the impacts of the levee extension on the delta it was assumed that there were approximately 30,000 acres of delta that would be east of the levee; 1,500 acres behind Reach 3; 7,000 behind Reach 4, 7,600 behind Reach 5 and 14,600 behind Reach 6. Then it was assumed that this delta would have an initial loss rate slightly higher than that of fresh marsh under the influence of the river or approximately 0.5 percent per year. However, as the levee became extended further, the marsh loss rate behind the previous reach was assumed to double to -1 percent per year and would double again with the next reach to -2 percent per year. This effect would occur because the sediments would be further removed from the delta in question and the rate of compaction and subsidence in newly formed delta is very high. Table G-8-4 compares the acres of delta without the levee extension and those with the extension. In this case the analysis was carried out to 2080 because the most significant losses occur between 2030 and 2080 as the isolated delta deteriorates.

G.8.16. Nonmarsh. Gains in nonmarsh habitat types due to construction of the levee extension were calculated in a manner similar to that described in paragraph G.8.10.

TABLE G-8-3

HYDROLOGIC UNIT V MARSH LOSS RATE AND ACREAGE BY TARGET YEAR
FOR THE CHANNEL ALINEMENT OF THE AVOCA ISLAND LEVEE EXTENSION

Target Year	Marsh Type					
	Western Fresh		Western Brackish		Saline	
	loss rate	acres	loss rate	acres	loss rate	acres
1980	0.33	96,033	0.37	57,216	0.87	107,337
1988	0.36	93,527	0.37	55,544	0.87	100,090
1993	0.43	91,165	0.37	54,524	0.87	95,811
2000	0.47	87,726	0.50	53,128	0.87	90,126
2003	0.56	86,495	0.52	52,335	0.87	87,794
2010	0.59	83,161	0.63	50,459	0.87	82,585
2014	0.63	81,216	0.73	49,199	0.88	79,749
2020	0.67	78,194	0.73	47,083	0.88	75,630
2024	0.69	76,119	0.84	45,723	0.89	73,003
2030	-	73,022	-	43,466	-	69,190

1/ Loss rate is percent per year until subsequent target year.

TABLE G-8-4

LOSS OF DELTA DUE TO THE AVOCA ISLAND LEVEE EXTENSION

Year	Acres of Delta Without-Project	Acres of Delta with Levee Extension
1980	10,100	10,100
1990	35,000	35,000
2000	59,900	59,900
2010	84,900	84,094
2020	110,000	108,103
2030	135,000	130,656
2080	135,000	113,728

G.8.17. Summary. When the estimated number of acres in 2030 with construction of entire Avoca Island levee extension are compared to number of acres that would exist under future without-project conditions, the following results are noted:

Fresh marsh:	-3,620 acres
Brackish marsh:	-1,245 acres
Saline marsh:	-150 acres
Delta:	-4,350 acres (an additional 17,000 acres would be lost by 2080)

It must be remembered that these calculations are only approximate and that the Avoca Island levee extension is not part of the recommended plan. During the next 4 years sediment transport and circulation patterns in the area would be studied and if the Avoca Island levee extension were recommended, the following impact assessment in the supplemental EIS would be far more precise than the above estimate.

Section 9 - TABLES OF INTEREST

G.9.1. Various tables of interest are included in this section. Table G-9-1 is the "National Audubon Society Blue List for 1979". Table G-9-2 is "Common and Scientific Names of Plants Referenced in this Report and Appendixes". Tables G-9-3 through G-9-13 show direct construction impacts of levee raising, by reach, for plans studied in detail.

TABLE G-9-1

NATIONAL AUDUBON SOCIETY "BLUE LIST" FOR 1979

Red-necked grebe	*Gull-billed tern
Western grebe	Least tern
*White pelican	*Black tern
*Double-crested cormorant	*Roseate tern
*Reddish egret	Common puffin
*Black-crowned night heron	*Yellow-billed cuckoo
*Least bittern	*Black-billed cuckoo
*American bittern	*Barn owl
*Wood Stork	*Burrowing owl
*White-faced ibis	*Short-eared owl
*Fulvous whistling duck	*Common nighthawk
*Canvasback	*Ruby-throated hummingbird
*Sharp-shinned hawk	*Red-headed woodpecker
*Cooper's hawk	Lewis' woodpecker
*Red shouldered hawk	*Hairy woodpecker
Swainson's hawk	*Purple martin
Ferruginous hawk	*Bewick's wren
Harris hawk	*Short-billed marsh wren
*Marsh hawk	Florida scrub jay
*Osprey	*Eastern bluebird
Caracara	Western bluebird
Prairie falcon	Mountain bluebird
*Merline	*Loggerhead shrike
*American kestrel	*Bell's vireo
Sharp-tailed grouse	*Warbling vireo
Sage grouse	*Yellow warbler
*King rail	*Yellow-breasted chat
*American oystercatcher	*Dickcissel
*Piping plover	*Grasshopper sparrow
*Snowy plover	*Henslow's sparrow
*Upland sandpiper	*Vesper sparrow
*Common tern	*Backman's sparrow

*Range includes project area.

TABLE G-9-2

COMMON AND SCIENTIFIC NAMES OF PLANTS REFERENCED IN THE REPORT AND APPENDIXES
(Arranged Alphabetically by Common Name)

COMMON NAME	SCIENTIFIC NAME
Alligatorweed	Alternanthera philoxeroides
American elm	Ulmus americana
Arrowhead	Sagittaria sp.
Ash	Fraxinus sp.
Aster	Aster sp.
Bahia grass	Paspalum notatum
Beggar's ticks	Bidens sp.
Bermuda grass	Cynodon dactylon
Bitter pecan	Carya aquatica
Blackberry	Rubus sp.
Black rush	Juncus roemarianus
Black willow	Salix nigra
Bluegrass	Poa sp.
Boxelder	Acer negundo
Broomsedge	Andropogon virginicus
Bulltongue	Sagittaria falcata
Butterweed	Senecio glabellus
Cattail	Typha sp.
Chinese tallow tree	Sapium sebiferum
Cockelbur	Xanthium sp.
Common ragweed	Ambrosia artemisiifolia
Coontail	Ceratophyllum demersum
Cottonwood	Populus deltoides
Cyperus	Cyperus sp.
Cypress	Taxodium distichum
Dallis grass	Paspalum dilatatum
Deciduous holly	Ilex decidua
Deer pea	Vigna repens
Dewberry	Rubus sp.
Drummond red maple	Acer rubrum var. drummondii
Duckweed	Lemna minor
Eastern baccharis	Baccharis halimifolia
Elderberry	Sambucus canadensis
Elephant's foot	Elephantopus sp.
Eurasian watermilfoil	Myriophyllum spicatum
Falsenettle	Boehmeria cylindrica
Fanwort	Cabomba caroliniana
Feather fingergrass	Chloris sp.
Goldenrod	Salidago sp.
Green ash	Fraxinus pennsylvanica
Greenbriar	Smilax sp.
Hackberry	Celtis laevigata

TABLE G-9-2
(Continued)

COMMON NAME	SCIENTIFIC NAME
Hawthorn	Crataegus sp.
Hog cane	Spartina cynosuroides
Horsetail	Equisitum sp.
Johnson grass	Sorghum halepense
Ladies eardrops	Brunnichia cirrhosa
Leadplant	Amorpha fruticosa
Live oak	Quercus virginiana
Lizard's tail	Saururus cernuus
Marsh elder	Iva fruteseens
Maidencane	Panicum hemitomon
Naiad	Najas sp.
Nuttal oak	Quercus nuttallii
Oak forest grass	Oplismenus setarius
Overcup oak	Quercus lyrata
Oystergrass	Spartina alterniflora
Palmetto	Sabal minor
Pennywort	Obolaria virginica
Peppervine	Ampelopsis arborea
Pondweed	Potamogeton
Poison ivy	Rhus sp.
Pumpkin ash	Fraxinus tomentosa
Rattan vine	Berchemia scandens
Roughleaf dogwood	Cornus drummondii
St. Johnswart	Hypericum sp.
Sandbar willow	Salix interior
Saltgrass	Distichlis spicata
Santa Maria	Parthenium hysterophorus
Sea-purslane	Sesuvium sp.
Shield fern	Thelypteris normalis
Shoal grass	Halodule beaudettei
Smartweed	Polygonum sp.
Smut grass	Sporobolus poiretii
Snowbell	Styrax sp.
Soft rush	Juncus effusus
Spiderlily	Hymenocallis occidentalis
Spikerush	Eleocharis sp.
Swamp privet	Forestiera acuminata
Sweetgum	Liquidambar styraeiflua
Sycamore	Platanus occidentalis
Three-cornered grass	Scirpus olneyi
Thoroughwort	Eupatorium sp.
Trumpet creeper	Campsis radicans
Turtle grass	Thalassia testudinum
Tupelo	Nyssa aquatica
Vasey grass	Paspalum urvillei

TABLE G-9-2
(Continued)

COMMON NAME	SCIENTIFIC NAME
Virginia creeper	Parthenaciscus quinquefolia
Water elm	Planera aquatica
Water hyacinth	Eichornia crassipes
Watermeal	Wolffia sp.
Water oak	Quercus nigra
Water willow	Justicia sp.
Waxmyrtle	Myrica cerifera
Widgeon grass	Ruppia maritima sp.
Wildcelery	Vallisneria americana
Willow	Salix sp.
Willow oak	Quercus phellos
Winter grass	Stipa sp.
Wiregrass	Spartina patens
Yankeeweed	Eupatorium capillifolium

TABLE G-9-3

DIRECT CONSTRUCTION IMPACTS OF RAISING LEVEES
WEST ATCHAFALAYA BASIN PROTECTION LEVEE
PLAN 2 FWO
(Acres)

Levee Reach	From ESBLHW[1/] to Open	From ESBLHW[1/] to Borrow	From Open to Open	From Open to Borrow	From LSBLHW[2/] to Open	From LSBLHW[2/] to Borrow	From CT[3/] to Open	From CT[3/] to Borrow	From Water to Open	From Water to Borrow
1395-1805			40	22	8					
W40	37		351	139	38	298			5	
W46-W49			300	136	121	458			17	51
W52-W49			260	202	72	197		74	13	116
W58			187	169		167			8	
W61			150	107	38	214			10	17
W64			120		163	501			36	86
W68			237			551		132	32	
W74	139	10	138					118		77
W78	150	396	200	92						10
W85		223	216					290		50
W86		68	30					70		
W91	70		100	20		102		84	65	
W95	87	21	136	125				100	80	
W99	53		30	60			28	245	38	25
W102			115	10			36	484	14	
W106			116	40		60		144	13	33
W112			120			128			30	
W117	20	30	174	180		20	20	88	8	
W121			64	6				80		6
W123			9							
W124			16							
TOTAL	556	748	3,109	1,308	440	2,696	84	1,909	369	471

1/ Early successional bottomland hardwoods

2/ Mid-to-late successional bottomland hardwoods

3/ Cypress-tupelo

TABLE G-9-4

DIRECT CONSTRUCTION IMPACTS OF RAISING LEVEES
WEST ATCHAFALAYA BASIN PROTECTION LEVEE
PLAN 4 EQ
(Acres)

Levee Reach	From ESBLHW[1] Open	to ESBLHW[1] Borrow	From Open Open	to Open Borrow	From LSBLHW[2] Open	to LSBLHW[2] Borrow	From CT[3] Open	to CT[3] Borrow	From Water Open	to Water Borrow
1395-1805			40	21	8					
W40	37		351	129	38	284				
W46-W49			300	136	121	458			17	51
W52-W49			260	137	53	141		54		96
W58			157	71		114				
W61			130	106	4	162				17
W64			120		140	356			16	60
W68			223			416		105	16	
W74	139	10	138					118		77
W78	109	244	200	92						10
W85		147	186					164		24
W86		68	30					70		
W91	45		100	20		102		84	40	
W95	28	21	136	125				100	27	
W99	46		30	60			25	245	26	25
W102			115	10			30	419	7	
W106			116	40		36		96	13	33
W112			120			80			30	
W117	20	30	174	142		20	20	88	8	
W121			64	6				80		6
W123			9							
W124			16							
TOTAL	424	520	3,015	1,095	364	2,169	75	1,623	200	399

[1]Early successional bottomland hardwoods

[2]Mid-to-late successional bottomland hardwoods

[3]Cypress-tupelo

TABLE G-9-5

DIRECT CONSTRUCTION IMPACTS OF RAISING LEVEES
WEST ATCHAFALAYA BASIN PROTECTION LEVEE
PLAN 7 NED
(Acres)

Levee Reach	From Open to ESBLHW[1/] Borrow: From Open	to ESBLHW[1/] Borrow	From Open to Open Borrow: From Open	to Open Borrow	From Open to LSBLHW[2/] Borrow: From Open	to LSBLHW[2/] Borrow	From Open to CT[3/] Borrow: From Open	to CT[3/] Borrow	From Open to Water Borrow: From Open	to Water Borrow
1395-1805			40	21	8					
W40	34		351	80	35	270				
W46-W49			300	131	118	445			13	51
W52-W49			260	137	50	141		54		96
W58			154	53		104				
W61			140	30		71				17
W64			120		135	331			11	55
W68			218			397		97	10	
W74	139	10	138					118		77
W78	109	244	200	92						10
W85		147	186					164		24
W86		68	30					70		
W91	45		100	20		102		84	40	
W95	28	21	136	125				100	27	
W99	46		30	60			25	245	26	25
W102			115	10			30	400	7	
W106			116	40		36		96	13	
W112			120			80			30	
W117	20	30	174	142		20	20	88	8	
W121			64	6				80		6
W123			9							
W124			16							
TOTAL	421	520	3,017	947	346	1,997	75	1,596	185	361

1/ Early successional bottomland hardwoos

2/ Mid-to-late successional bottomland hardwoods

3/ Cypress-tupelo

TABLE G-9-6

DIRECT CONSTRUCTION IMPACTS OF RAISING LEVEES
WEST ATCHAFALAYA BASIN PROTECTION LEVEE
PLAN 9 RECOMMENDED
(Acres)

Levee Reach	From ESBLHW[1/] to Open	ESBLHW[1/] to Borrow	From Open to Open	Open to Borrow	From LSBLHW[2/] to Open	LSBLHW[2/] to Borrow	From CT[3/] to Open	CT[3/] to Borrow	From Water to Open	Water to Borrow
1395-1805			40	20	8					
W40	32		351	91	32	251				
W46-W49			300	131	118	445			13	51
W52-W49			260	135	46	142		52		95
W58			155	59		107				
W61			151	52		106				17
W64			120		137	340			13	57
W68			218			397		97	10	
W74	139	10	138					118		77
W78	109	244	200	92						10
W85		147	186					164		24
W86		68	30					70		
W91	45		100	20		102		84	40	
W95	28	21	136	125				100	27	
W99	46		30	60			25	245	26	25
W102			115	10			30	436	7	
W106			116	40		36		96	13	
W112			120			80			30	
W117	20	30	174	142		20	20	88	8	
W121			64	6				80		6
W123			9							
W124			16							
TOTAL	419	520	3,029	983	341	2,026	75	1,630	187	362

1/ Early successional bottomland hardwoods

2/ Mid-to-late successional bottomland hardwoods

3/ Cypress-tupelo

TABLE G-9-7

DIRECT CONSTRUCTION IMPACTS OF RAISING LEVEES
EAST ATCHAFALAYA BASIN PROTECTION LEVEE
PLAN 2 FWO
(Acres)

Levee Reach	From ESBLHW[1] to Open	From ESBLHW[1] to Borrow	From Open to Open	From Open to Borrow	From LSBLHW[2] to Open	From LSBLHW[2] to Borrow	From CT[3] to Borrow	From Water to Open	From Water to Borrow	From BLHW/CT to Borrow
E14			112	124		92				
E16			127	185	60	179		30		
E22			100	169	46	195		21		
E28			86	10	60	371		21		
E33			111		54	586		119		
E36			181		50	564		131		
E40	63	214	203	30		197		4		
E44	178		312			573		38	17	
E50 & E52	112		111			370		102	26	
E54	26		56			112		5		
E58	47		138			272		5		
E61	8		60			16		5		
E64	40		80		40	223		44		
E68 & E69	7	9	68			40		20		20
E73	30		133	8		130	67	71	33	
E74	5		47			220	32	23	10	
E75	4		24					2		
E76	15		56				25	14	30	
E77	50		108				50	13	50	
E84	10		65				144			
E85		2	21							
E87			106				43			
E89			100							12
TOTAL	595	225	2,345	526	310	4,140	361	668	166	32
Avoca Island	43		261		10	Minor impacts only - I wall				

1/ Early successional bottomland hardwoods

2/ Mid-to-late successional bottomland hardwoods

3/ Cypress-tupelo

TABLE G-9-8
DIRECT CONSTRUCTION IMPACTS OF RAISING LEVEES
EAST ATCHAFALAYA BASIN PROTECTION LEVEE
PLAN 4 EQ
(Acres)

	From ESBLHW[2/] to		From Open to		From LSBLHW[2/] to		From CT[3/] to	From Water to		From BLHW/CT to
Levee Reach	Open	Borrow	Open	Borrow	Open	Borrow	Borrow	Open	Borrow	Borrow
E14			112	105		76				
E16			127	126	60	80				
E22			100	83	32	119				
E28			86		60	226				
E33			111		42	442		114		
E36			181		40	546		121		
E40	63	214	151	7		72		2		
E44	178		312			419			17	
E50 & E52	112		111			280		66	26	
E54	21		56			57		4		
E58	40		124			108		3		
E61	8		60			16		5		
E64	40		80		40	223		44		
E68 & E69	7	9	68			48			20	20
E73	30		133	8		82	67	58	33	
E74	5	47				96	22	20	10	
E75	4	24						2		
E76	10		56				25	14	30	
E77	50		108				50	13	50	
E84	10	2	65				144			
E85			21							
E87			106				43			
E89			100							12
TOTAL	578	225	2,339	329	274	2,890	351	466	186	32
Avoca Island	43		261		10	Minor impacts only - I wall				

1/ Early successional bottomland hardwoods

2/ Mid-to-late successional bottomland hardwoods

3/ Cypress-tupelo

TABLE G-9-9

DIRECT CONSTRUCTION IMPACTS OF RAISING LEVEES
EAST ATCHAFALAYA BASIN PROTECTION LEVEE
PLAN 7 NED
(Acres)

Levee Reach	From ESBLHW[1/] to Open	From ESBLHW[1/] to Borrow	From Open to Open	From Open to Borrow	From LSBLHW[2/] to Open	From LSBLHW[2/] to Borrow	From CT[3/] to Borrow	From Water to Open	From Water to Borrow	From BLHW/CT to Borrow
E14			95	44		32				
E16			127	126	60	80				
E22			100	69	32	117				
E28			86		46	202				
E33			111		38	442		111		
E36			181		40	534		121		
E40	63	214	125	7				2		
E44	153		312			323			17	
E50 & E52	112		111			250			26	
E54	20		56			40		3		
E58	40		124			108		3		
E61	8		60			61		5		
E64	40		80		40	223		44		
E68 & E69	7	9	68			40			20	20
E73	30		133	8		70	67	58	33	
E74	5		47			156	22	20	10	
E75	4		24					2		
E76	15		56				25	14	30	
E77	50		108				50	13	50	
E84	10		65				144			
E85		2	21							
E87			106				43			12
E89			100							
TOTAL	557	225	2,296	254	256	2,678	351	396	186	32
Avoca Island	43		261		10	Minor impacts only - I wall				

1/ Early successional bottomland hardwoods

2/ Mid-to-late successional bottomland hardwoods

3/ Cypress-tupelo

TABLE G-9-10

DIRECT CONSTRUCTION IMPACTS OF RAISING LEVEES
EAST ATCHAFALAYA BASIN PROTECTION LEVEE
PLAN 9 RECOMMENDED
(Acres)

Levee Reach	From Open	ESBLHW[1/] to Borrow	From Open	Open to Borrow	From Open	LSBLHW[2/] to Borrow	From CT[3/] to Borrow	From Open	Water to Borrow	From BLHW/CT to Borrow
E14			95	44		32				
E16			127	126	60	80				
E22			100	66	32	112				
E28			86		46	226				
E33			111		42	442		114		
E36			181		40	534		121		
E40	63	214	51	7		72		2		
E44	128		312			419			17	
E50 & E52	112		111			250			26	
E54	20		56			40		3		
E58	40		124			108		3		
E61	8		60			61		5		
E64	40		80		40	223		44		
E68 & E69	7	9	68			40			20	20
E73	30		133	8		82	67	58	33	
E74	5		47			158	22	20	10	
E75	4		24					2		
E76	15		56				25	14	30	
E77	50		108				50	13	50	
E84	10		65				144			
E85		2	21							
E87			106				43			
E89			100							12
TOTAL	532	225	2,222	251	260	2,879	351	399	186	32
Avoca Island	43		261		10	Minor impacts only - I wall				

[1/]Early successional bottomland hardwoods

[2/]Mid-to-late successional bottomland hardwoods

[3/]Cypress-tupelo

TABLE G-9-11

DIRECT CONSTRUCTION IMPACTS OF RAISING LEVEES
WEST OF BERWICK
PLAN 2 FWO
(Acres)

	From ESBLHW[1]	to	From Open	to	From LSBLHW[2]	to	From CT[3]	to	From Water	to	From Fresh Marsh	to
	Open	Borrow	Open	Borrow	Open	Borrow	Open	Borrow	Open	Borrow	Open	Borrow
Wax Lake East	60	174	100		50	307		38		40		151
Wax Lake East Outlet		10	48	8	24	2						
Wax Lake West Outlet			43		87	39						
Wax Lake West			35	10	15	95						
East Bayou Sale			48	20			47	132				
West Bayou Sale A			43	28			22	86				
West Bayou Sale B			43	38			21	76			21	38
Teche Ridge 1			30	10	8	10		45				
Teche Ridge 2 & 3			18	2	8	10		30				
TOTAL	60	184	408	116	192	463	90	407		40	21	189
PLAN 4 EQ												
Wax Lake East	98	204	100		90	422		44	6	50		165
Wax Lake East Outlet		10	55	19	27	4						
East Bayou Sale			50	55			85	324	33			
West Bayou Sale A			75	78			37	231	26			
West Bayou Sale B			64	81			32	162	45		32	81
Teche Ridge 1			30	25	8	20	6	105	7			
Teche Ridge 2 & 3			18	7	8	42		121	7			
TOTAL	98	214	392	265	133	488	160	987	124	50	32	246

[1] Early successional bottomland hardwoods

[2] Mid-to-late successional bottomland hardwoods

[3] Cypress-tupelo

TABLE G-9-12

DIRECT CONSTRUCTION IMPACTS OF RAISING LEVEES
WEST OF BERWICK
PLAN 7 NED
(Acres)

	From ESBLHW[1/] to Open	From ESBLHW[1/] to Borrow	From Open to Open	From Open to Borrow	From LSBLHW[2/] to Open	From LSBLHW[2/] to Borrow	From CT[3/] to Open	From CT[3/] to Borrow	From Water to Open	From Water to Borrow	From Fresh Marsh to Open	From Fresh Marsh to Borrow
Wax Lake East	126	215	100		100	430		48	8	54		56
Wax Lake East Outlet		10	55	18	27	4						
East Bayou Sale			50	98			124	349	33			
West Bayou Sale A			99	98			49	294	26			
West Bayou Sale B			88	96			44	194	45		45	96
Teche Ridge 1			30	30	8	25	8	45	9			
Teche Ridge 2 & 3			18	9	8	53		154	13			
TOTAL	126	225	440	349	143	512	225	1,084	134	54	45	152

PLAN 9 R

	From ESBLHW[1/] to Open	From ESBLHW[1/] to Borrow	From Open to Open	From Open to Borrow	From LSBLHW[2/] to Open	From LSBLHW[2/] to Borrow	From CT[3/] to Open	From CT[3/] to Borrow	From Water to Open	From Water to Borrow	From Fresh Marsh to Open	From Fresh Marsh to Borrow
Wax Lake East	126	218	100		100	345		48	9	54		185
Wax Lake East Outlet		10	55	20	27	4						
East Bayou Sale			50	98			124	349	33			
West Bayou Sale A			99	98			49	294	26			
West Bayou Sale B			88	96			45	193	45		45	96
Teche Ridge 1			30	3	8	25	8	129	9			
Teche Ridge 2 & 3			18	9	8	53		154	13			
TOTAL	126	218	440	324	143	427	226	1,167	135	54	45	281

1/ Early successional bottomland hardwoods

2/ Mid-to-late successional bottomland hardwoods

3/ Cypress-tupelo

TABLE G-9-13

DIRECT CONSTRUCTION IMPACTS
ATCHAFALAYA RIVER LEVEES AND MORGANZA LEVEE
(Acres)

	From ESBLHW[1/] to Levee	From ESBLHW[1/] to Borrow	From Open to Levee	From Open to Borrow	From LSBLHW[2/] to Levee	From LSBLHW[2/] to Borrow
WEST ATCHAFALAYA RIVER LEVEE						
Plan 2 FWO	2	270	30	30	0	0
Plan 4 EQ	2	180	400	30	0	0
Plan 7 NED	2	160	390	30	0	0
Plan 9 TSP	2	160	390	30	0	0
EAST ATCHAFALAYA RIVER LEVEE						
Plan 2 FWO	0	10	10	20	10	0
Plan 4 EQ	0	10	10	20	10	0
Plan 7 NED	0	10	10	10	10	0
Plan 9 TSP	0	10	10	10	10	0
MORGANZA LEVEE						
Plan 2 FWO	0	0	-	0	0	-
Plan 4 EQ	0	0	60	0	0	10
Plan 7 NED	0	0	60	0	0	10
Plan 9 TSP	0	0	60	0	0	10

[1/] Early successional bottomland hardwoods.

[2/] Mid-to-late successional bottomland hardwoods.

Section 10 - LITERATURE CITED

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Section 11 - 404(b)(1) EVALUATIONS

G.11.1 The provisions of Section 404 of the Clean Water Act for all project features except levees, floodwalls and bank stabilization will be met via the Section 404(r) process by the submission of this EIS, including a Section 404(b)(1) Evaluation, to Congress for appropriation and/or authorization action. The levees, floodwalls, and bank stabilization features will meet Section 404 provisions by preparation of a Section 404(b)(1) Evaluation. A Public Notice will be prepared and a Water Quality Certificate will be requested from the State of Louisiana for these three features. This course is necessary because items of these three authorized features are scheduled for construction in the near future and the Section 404(r) exemption process is too lengthy to complete prior to construction on these items. Certain other features are also authorized. If it is deemed necessary to construct any of these features prior to completion of the Section 404(r) process, the Public Notice/State Water Quality Certification process will be utilized.

G.11.2 The necessary project features comprising the Recommended Plan have been evaluated with respect to Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material, published by the US Environmental Protection Agency on 24 December 1980. These evaluations are included in Appendix G of this report. Since the 404(b)(1) Evaluation for levees and floodwalls is not complete at this time and since those features will meet Section 404 provisions via a State of Louisiana Water Quality Certificate, this Evaluation is not included in Appendix G. Bank stabilization will also meet Section 404 provisions via the same route, but since the 404(b)(1) Evaluation is complete, the Evaluation is included in Appendix G. Separate evaluations have been written for each feature (at the informal request of the US EPA) except where features are clearly interrelated such as channel training above Morgan City with outlet flow distribution and management units with diversion structures. Some of these evaluations will be refined and updated when more site-specific water, sediment, and disposal area physical and/or chemical data become available.

G.11.3 The following synthetic hydrocarbons were sampled in the Atchafalaya Basin, and analyzed in 1981: aldin, chlordane, DDD, DDE, DDT, dieldrin, endrin, heptachlor, heptachlor epoxide, lindane, PCB-1242, -1248, -1254, -1260, toxaphene, mirex, and methoxychlor. Results of those analyses are not shown on the tables because the minimum detection limits were generally well above current EPA criteria levels and definite conclusions as to release potentials could not be drawn.

Bank Stabilization

I. Introduction. A comprehensive plan for flood control in the Atchafalaya River was authorized by the Flood Control Act of 1928 under the Mississippi River and Tributaries Project (MR&T). The Act provided for the construction of a system of improvements to increase channel capacity, including revetments, dikes, dredging, and other features such as floodwalls, floodgates, cutoffs, and pumping plants, to enable the Lower Mississippi River System and its tributaries to pass the project design flood. A key feature of the project is the construction of revetment works to stabilize the river bank and protect the levee system which confines the Atchafalaya River channel.

A Public Notice was issued by the New Orleans District on 15 March 1976 to acquaint governmental agencies and the interested public with Corps of Engineers' intentions to construct a series of revetment works on the Atchafalaya River. A Statement of Findings, issued on 25 May 1976, summarized comments received on the Public Notice and concluded that the benefits associated with construction and maintenance of the revetments far outweighed the minor detrimental aspects. The US Environmental Protection Agency (USEPA), by letter dated 10 June 1976, concurred with the Corps' determination to proceed. Since that time, additional revetment works needed to stabilize caving and eroding banks have been identified to protect the levee system.

This evaluation is being prepared under Section 404 of the Clean Water Act of 1977 using guidelines promulgated by USEPA on 24 December 1980. These guidelines require that construction involving dredged or fill material taking place after 1 October 1981 be evaluated to determine: that no practical alternative exists which will have less adverse impact on the aquatic ecosystem; that appropriate State and Federal Water Quality Standards will not be violated; that the discharge will not contribute to significant degradation of waters of the United States; and that all possible steps have been taken to minimize potential adverse impacts on the aquatic ecosystem. Additionally, marine sanctuaries, endangered or threatened species, and critical habitat shall not be jeopardized.

II. Project Description.

a. Location. The project occupies portions of the Red and Atchafalaya Rivers' banks and channels from the Old River outflow channel to Atchafalaya River mile 55.0, and a 0.5 mile reach of the Atchafalaya River at river mile 115. Plate 1 is a general map of the area.

b. General Description. The project would consist of the construction of revetments at various locations along the river to retard bank erosion and protect the mainline levees. The plan would call for the construction of a total of 65 miles of revetment works at 41 sites along the river. Of this total, 41 miles have been constructed and 24 miles remain to be constructed. Table G-11-1 lists the revetments, location, construction completed and remaining construction. Plates 2 through 7 show the location of the revetment sites. Articulated concrete mattress (ACM) would be placed on graded banks from the low water line riverward. Exposed banks would be paved with stone. The project is scheduled for completion in the year 2000.

c. Authority and Purpose. The Flood Control Act of 1928, as amended by subsequent Acts of Congress, provides for channel improvement in the MR&T. The plan of improvements includes construction of revetments to stabilize the river banks and to protect mainline levees.

d. General Description of Dredged or Fill Material.

(1) General characteristics of material.

(a) Holocene soils are encountered along the Atchafalaya River bank in this section of the river. They include mainly alluvial deposits with some point bar deposits and interdistributary and deltaic plain sediments. Alluvial and point bar materials consist of silts and clays. Deltaic plain sediments are interfingered masses of silts and clays, while the interdistributary materials are comprised of clay wedges formed between major distributaries. Undifferentiated Pliocene-Miocene Series deposits underlie the Holocene materials in a narrow east-west band across the basin. Plate 8 shows the complex surface distribution pattern of these deposits through the construction area.

(b) The below-water portion of the revetment would be an ACM, placed as a continuous layer of concrete block from a specially designed floating plant. The mattress would extend from the low water line to approximately 50 feet beyond the deepest part of the river bed. The ACM would be made from precast concrete units (squares) each measuring 4 feet by 25 feet by 3 inches. The squares would be connected by wire imbedded in the concrete which would be looped through the square to form the mattress. Stone would be placed in a 10-inch layer from the shoreward edge of the concrete mattress to the top of the degraded bank. The stone would be of a hard, durable quality and would be reasonably well-graded between 6 and 125 pounds. Before placement of the mattress, an upper layer of shell or gravel would be placed from midway between the water line and the top of the degraded bank to 5 feet below the water for temporary erosion protection.

TABLE G-11-1

REVETMENTS

Location (River mile)		Revetment Name	Total	Amount (miles) Completed	Amount (miles) Uncompleted
9	R*	Long Lake	1.5	1.2	0.3
5	L*	Turnbull Island	2.0	1.3	0.7
2	R*	Naples	1.2	1.2	0.0
1	L	Mile One	0.8	0.8	0.0
2.5	R	Coville Bayou	1.6	1.2	0.4
4.0	L	Legonier	2.0	1.7	0.3
5.5	R	Simmesport	2.4	2.0	0.4
7.5	L	Kuhlman Bayou	1.0	1.0	0.0
8.0	R	Odenburg	1.5	1.0	0.5
10.0	L	Jacoby	1.7	0.0	1.7
12.5	R	Cason	2.0	2.0	0.0
13.5	L	McCrea	1.3	1.0	0.3
14.5	R	Woodside	3.1	2.5	0.6
17.0	L	Provosty	2.0	1.5	0.5
18.5	R	Crooked Bayou	2.1	1.8	0.3
21.5	L	Mercier	2.8	2.0	0.8
23.5	R	Barberton	0.9	0.7	0.2
24.0	L	Evans Point	1.3	0.9	0.4
25.5	R	Goudeau	1.0	0.8	0.2
26.5	L	Morris Bayou	1.2	0.7	0.5
27.5	R	Goodwood	1.6	1.6	0.0
28.5	L	Red Cross	1.6	1.5	0.1
29.5	R	Melville	1.5	0.9	0.6
31.0	L	Cross Bayou	1.1	0.7	0.4
32.0	R	Melville South	1.7	0.8	0.9
34.6	L	Toles	2.0	1.2	0.8
35.5	R	Petite Prairie	1.6	1.6	0.0
37.0	L	Holloway Lake	1.4	1.4	0.0
38.0	R	Three Mile Bayou	0.7	0.0	0.7
38.5	L	Bayou Sherman	1.0	1.0	0.0
40.5	R	Krotz Springs	3.0	0.9	2.1
40.5	L	East Krotz Springs	1.4	0.0	1.4
43.5	L	Sherburne	1.8	1.3	0.5
44.5	R	Bayou Big Graw	2.7	1.6	1.1
48.0	L	Coswell Bayou	1.1	0.0	1.1
48.5	R	Courtableau Bayou	1.2	0.0	1.2
50.0	L	Alabama Bayou	1.4	0.0	1.4
52.0	R	Indian Bayou	1.4	0.0	1.4
53.0	L	Happytown	1.3	0.0	1.3
54.0	R	Otis Landing	1.1	0.0	1.1
115.0	L	Morgan City Front	1.1	0.6	0.5
		TOTAL	65.1	40.4	24.7

* Red River

(2) Quantities of Material. The volume of upper bank soils that would be graded into the river during the 18-year construction period (1982-2000) is approximately 11,950,000 cubic yards. Total gravel, oyster shell, or stone that would be placed on the upper river bank is approximately 1,123,300 tons, while 430,200 squares of ACM would be placed below the LWRP. Based on an annual average construction rate of 1.3 miles per year, approximately 650,000 cubic yards of material would be dredged into the river each year, while 61,100 tons of gravel, oyster shell and stone, and 23,400 squares of ACM would be placed on the river bank. Approximately 300,000 cubic yards of bank grading, 12,000 tons of stone and 10,000 squares of ACM would be involved in annual maintenance work.

(3) Source of Material. The material graded into the river would be naturally occurring alluvium from the river bank. Stone and gravel would be obtained from various quarries and gravel pits in the Lower Mississippi Valley. Concrete blocks forming the ACM would be manufactured at casting fields at several locations along the river.

e. Description of the Proposed Discharge Sites.

(1) Location. The locations of revetments to be constructed are shown on Plates 2 through 7.

(2) Size. Disposal areas would be the river banks, channel slopes, and adjacent water column where bank grading and revetment placement occur. The average lengths of the revetment construction sites would vary from approximately 1,000 feet to approximately 11,580 feet. Graded materials would be deposited on the channel slope to a distance of approximately 200 feet riverward of the low water line. The project would require approximately 2400 acres of bank and river bed to be covered by ACM.

(3) Type of Site. The disposal and fill sites would be unconfined and in open water.

(4) Types of Habitat. Existing habitat consists of natural bank habitats, including early and mid-to-late successional bottomland hardwoods and cypress-tupelo. Approximately 130 acres of bottomland hardwoods and 120 acres of cypress-tupelo would be impacted. The areas that are cleared for construction access, but not revetted would revegetate with early successional bottomland hardwoods. Existing subaqueous habitat is characterized by moving sediments, the majority of silt or clay size.

(5) Timing and Duration of Discharge. Revetment construction and repair would be done during the low water season, beginning with bank clearing and degrading in late August and September, and continuing with revetment placement repairs until complete, in November or early December. Each phase of work would proceed

sequentially by site in the upstream direction. The duration of discharge would be concurrent with the bank grading and revetment placing operations, and would vary from a few days to a month or more, depending on the size of the job. Maintenance work at and near construction sites would normally be performed during the construction phase.

f. Description of Disposal Method. The construction site would first be cleared of vegetation and debris. Clearing would extend to about 150 feet landward of the top of bank, and be accomplished by bulldozers, draglines, and smaller equipment. Removed material would be either buried, spread along the landward limit of the site or be completely removed from the site. Clearing limits would normally be about 50 feet beyond the area to be degraded to provide adequate accessibility for all operations.

The bank would then be degraded to a predetermined stable slope. Bulldozers would excavate and move material from above the water line toward the river, from where barge-mounted draglines would pull the material by excavating with the large scraper equipped with cutting teeth along its bottom edge. The excavated material would be engulfed and pulled by the scraper beyond the grading limits and be deposited on the channel slope. Some of the material would be carried away by river currents, while the rest would remain to be covered by the ACM. Degrading is not usually extended to below 15 feet of the low-water line at time of construction. A 6-inch layer of shell or gravel would then be placed on the finished slope to prevent erosion before placement of the ACM. This material would continue to serve as a filter medium after revetment placement.

The ACM would then be installed over the entire degraded area and riverward to about 50 feet beyond the channel thalweg (deepest point). Beginning at the downstream work limit, a barge would be positioned against the bank for the purpose of assembling and launching the precast (25 by 4 feet) concrete squares. After each row of squares was assembled and tied to plate anchors on the bank, it would be lowered from the barge to the river bank and the next row of squares would then be tied together and to the preceding row with wire, and the sequence repeated until the required riverward limit of that section was reached. Each subsequent section (upriver) would be placed to overlap that previously placed to ensure complete coverage. This method of construction would minimize any tendency for river currents to flip the upstream edge of an ACM section. At the upstream end of the site, a double thickness of ACM would be placed for the same reason.

Upper bank paving with stone would follow the ACM placement. Barge-mounted draglines would lift the stone from another barge and deposit it along the degraded bank.

Major maintenance work might consist of replacing portions of an ACM where erosion has occurred. If bank erosion has occurred in upper bank areas, degrading would first be accomplished to a stable slope as before, and ACM placement and upper bank paving would then be accomplished to complete the process.

III. Factual Determinations.

a. Physical Substrate Determinations.

(1) Substrate Elevation and Slope. The soils graded into the river from banks would generally be transported by currents as suspended or bed load for a short period. Therefore, no significant changes in elevation or slope of the channel bottom would be expected as a result of grading bank materials into the river. The placement of revetment on the graded bank would result in a change in bank slope and elevation from that of the generally steep and irregular natural bank to a uniform slope ranging from 1 vertical on 3 horizontal to 1 vertical on 7 horizontal. The average graded slope would be 1 vertical on 5 horizontal.

(2) Sediment Type. Bank grading would not result in significant alteration in sediment composition of the receiving area since the material to be graded would be of alluvial origin and of similar grain size. The ACM revetment would result in a change in substrate from alluvial sediments to concrete mattress on the lower bank. The upper bank protection materials would result in a change in substrate from alluvial sediments to stone and shell or gravel on the upper bank. Interstices between ACM slabs, buckling of the mat, and deposition of sediments on the revetment would provide some natural substrate.

(3) Dredged Material Movement. Most of the soil graded from the river bank into the channel would be transported downstream as bed or suspended load by currents. Some of the graded material would remain along the underwater bank to be covered by the concrete mattress.

(4) Physical Effects on Benthos. Construction of the revetment and consequent river disposal of soils would destroy existing benthic populations over 2,400 acres of river bottoms. Due to high turbidity, shifting substrates, and high current velocities, the Atchafalaya River generally does not support a large benthic community. However, the bank areas and channel area above the river bed, although representing a limited percentage of the underwater area, are highly productive at all trophic levels. Factors which cause this productivity include reduced current velocity, increased availability of cover, and substrates exposed to sufficient light to

allow algae growth. These bank areas would be permanently altered at all revetment sites. In time, sediment deposition on the revetment would restore some areas of original habitat and sparse recolonization would occur by epibenthos on the ACM.

b. Water Circulation, Fluctuation, and Salinity Determination.

(1) Effects on Water.

(a) Salinity. No substantive effects.

(b) Water Chemistry. Alkalinity and pH would not be significantly altered by the proposed revetment action due to the similarity of soils, the high suspended sediment capacity of the river, and the frequency of natural bank erosion. The construction materials would not affect water chemistry since cement and stone are essentially inert.

(c) Clarity. Water clarity would be reduced during the grading and disposal operation, creating a sediment plume which would be visible downstream of each site. This condition would be temporary and would dissipate after the grading and disposal is complete. The revetment itself would not significantly affect water clarity, but the cumulative effect of all Atchafalaya River channel improvements may be improvements of river water clarity.

(d) Color. Water color would be affected similarly to water clarity.

(e) Odor and Taste. No sustained effects on water odor or taste would be expected as a result of revetment construction.

(f) Dissolved Gases. The only dissolved gas of concern is oxygen. Data from 2 years of monitoring by Louisiana State University indicates DO is highest in January-February and lowest during July-August-September. Much of this seasonal change is due to temperature alone since colder water holds more oxygen in solution. The low discharge rate of the late summer and fall further contributes to the seasonal low in DO levels. In November the fall phytoplankton bloom usually occurs, thereby stimulating DO levels. Revetment construction occurring in the fall months would be expected to have short-term adverse effects on DO in the vicinity of each revetment site because of disturbed photosynthesis whenever turbidity levels are raised.

(g) Nutrients. Nitrogen and phosphorus levels are normally adequate in the Atchafalaya River but do not lead to eutrophic conditions since the high turbidity of the river prevents abundant plant growth. No significant effect would therefore be expected from graded sediments releasing nutrients into the water.

Ammonia is also present and is toxic to aquatic life in un-ionized form. However, at the nearly neutral pH of the river the percent of ammonia-nitrogen in un-ionized form would be low. Together with a large dilution capacity this fact should prevent any toxic ammonia problems.

(h) Eutrophication. No eutrophication problems would be expected as a result of disposal of bank soils into the river. High turbidity maintains a limited photic zone, thereby inhibiting plant growth.

(2) Current Patterns and Circulation.

(a) Current Patterns and Flow. Revetment structures would stabilize caving and eroding banks, thereby achieving a more consistent channel alinement. Overall, current patterns would not be grossly altered. Revetment placed on concave banks of bendways would tend to cause channel deepening at the toe of the revetment and narrowing of river width with resulting localized increases in velocities and bed scour.

(b) Velocity. The smooth texture and even grade of the revetment structure, compared with the existing irregular banks, would tend to increase velocities in the immediate area of the revetment.

(c) Stratification. Revetment works would not induce stratification in the naturally turbulent river.

(3) Normal Water Level Fluctuations. Individual revetment sections would not have measurable effects on water level fluctuations. However, the effect of the complete revetment program would be to lower stages because of channel deepening caused by higher velocities and lack of available bank sediment. The resulting deeper channel would have an increased hydraulic efficiency resulting in generally lower river stages.

(4) Salinity Gradients. Not applicable.

(5) Actions Taken to Minimize Impacts. Other than construction of revetment sections to desired grade and careful engineering to insure construction to desired specifications, no actions would be taken to minimize impacts.

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Sites. The grading operation would increase suspended particulate and turbidity levels in the channel at and downstream of the work site during construction.

(2) Effects on Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Light penetration would be decreased in the vicinity of each revetment during construction. This effect would disappear after cessation of construction activities.

(b) Dissolved Oxygen. The 12 million cubic yards to be removed from the river banks could add an average of 228,000 tons of COD to the main channel water during the construction period. This quantity of COD would correspond to approximately the mean background load of COD of the Atchafalaya River over an 11-day period. This incremental increase in daily COD should not cause significant dissolved oxygen reductions beyond the zones required for mixing and dispersion.

(c) Toxic Metals and Organics. The amount of suspended sediment carried by the Atchafalaya River is dependent on streamflow, turbulence, sediment particle size, water temperature, and sediment availability. Commonly more than 90 percent of the contaminant load is associated with suspended sediment, thus keeping dissolved contaminant concentrations low. Suspended sediment discharges at Simmesport at the head of the project area show that an average of 108 million tons of total suspended sediment flows through the project area annually. Approximately 77 percent is silts and 23 percent sand. The annual average suspended solids concentration is 550 mg/l. During the construction season, August through December, suspended solids range from a low of about 55 mg/l to a high near 550 mg/l, with the concentration dependent upon streamflow, turbulence and availability of sediments. The bank grading operation and the placement of revetment on the graded bank would not be expected to significantly increase contaminants in river waters. The bank soils graded into the river were deposited and have been reworked by the river over time. As a result, the reintroduction of sediment to the river channel should not constitute an additional loading of the system with contaminant materials. Natural bank caving by fluvial action is continuous and occurs on bank lines where the revetment is constructed. The river is steadily reintroducing the alluvial bank soils to main channel waters. The construction work would accelerate, to a moderate degree, the introduction of the soils into the river. Revetment works would tend to retard bank erosion and reduce the further introduction of sediments into the river over the long term. With the lack of significant industrial, municipal or agricultural drainage areas in this reach of the Atchafalaya River, river bank materials are expected to be comparatively free of contaminants. Table G-11-2 displays results of a single sample analysis completed in 1981 at River Mile 55. The elutriate tests did not detect the introduction of any toxics due to discharge of bank sediments into the river, although some substances could not be measured at levels comparable to EPA criteria.

TABLE G-11-2

WATER AND SEDIMENT DATA
SITE NO. 5, 1981
ATCHAFALAYA RIVER, MILE 55

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Total Solids, % by Wgt					68.9
Total Volatile Solids					0.96
Turbidity	53,000				
Suspended Solids	55,300				
Volatile Suspended Solids	18,400				
Oil and Grease					990
Chlorides	30,000				
COD	28,000	11,000	17,000		20,500
TKN	580		1,180		168
Cyanide	< 10		< 10	3.5	
Phenols	< 10		< 10	2,600	
Nitrite-N	37		39		< 0.20
Nitrate-N	1,320		1,170		< 0.20
Total Nitrogen-N	1,900		2,390		168
Ammonia-N	41		542	20**	10.7
OrthoPhosphate-P	76	78	22		2.10
Total Phosphorus-P	180	< 100	< 100		345
Calcium	37,400	36,900	40,700		
Magnesium	10,600	10,100	11,100		
Manganese	117	< 1	1,240		233
Iron	3,960	198	71	1,000	7,810
Mercury	< 0.2	< 0.2	< 0.2	0.20	< 0.10
Lead	3	1	< 1	3.8*	86.3
Zinc	< 25	< 25	< 25	47	44.6
Chromium	1	< 1	< 1	0.29	8.88
Cadmium	0.3	0.3	< 0.1	0.025*	0.21
Copper	4	2	3	5.6	6.63
Nickel	2	< 1	< 1	96*	18.2
Arsenic	2	1	< 1	40	3.32

* Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.
**Criterion is for un-ionized ammonia, which would comprise about 1 percent of total ammonia at anticipated pH and temperature conditions.

(d) Pathogens. The small amounts of untreated waste that normally enter the river channel directly or through erosion of sediments should not increase significantly because of bank grading operations.

(e) Esthetics. During construction the temporary plume of turbidity might not be visually pleasing to many observers.

(3) Effects on Biota.

(a) Primary Production. The Atchafalaya River is a detritus-based system with fine particulate and dissolved organic matter from the watershed and floodways providing the primary energy source for the ecosystem. Consequently, aquatic primary productivity in the main river channel is not of major importance in the energy budget of the river ecosystem. High ambient turbidity, shallow euphotic zone, and natural turbulence of the river diminish the importance of primary productivity and photosynthetic activity in the river channel. Short term effects of the bank grading operation on primary productivity and photosynthetic activity would be considered insignificant. Long term and cumulative effects of bank stabilization with revetment placement might be an overall decrease in river turbidity and an increase in the importance of primary productivity of the river system.

(b) Suspension/Filter Feeders. Increases in suspended particulates associated with bank grading would not be expected to significantly affect suspension feeding benthic organisms outside the immediate locations of the construction sites. Suspension feeding macroinvertebrates in the river are adapted to the normally high concentrations of suspended particulates although some mortality could occur among sedentary species during construction. Those mobile suspension or filter-feeding organisms might vacate the area downstream until conditions returned to near normal. Recolonization after revetment operations ceased would be expected to be rapid in areas with unaltered habitat.

(c) Sight Feeders. No significant effects are expected on sight-feeding species. Sight feeders, principally fish species, would vacate or avoid the construction site and associated area of increased suspended particulates during the period of construction activity. Fish species in the Atchafalaya River are adapted to naturally high turbidity or suspended solids levels.

(4) Actions Taken to Minimize Impacts. No actions to minimize impacts during construction would be taken.

d. Contaminant Determinations. Data taken by the Corps of Engineers on dredging operations in the Lower Atchafalaya River have shown that contaminant levels of main channel waters would not be increased over ambient levels. Although dredging operations differ considerably, the bank grading operation and placement of revetment on the bank would not be expected to introduce new contaminants, but might temporarily increase or relocate contaminants in the river water during construction. Since no significant contamination would be expected no further testing of sediments was done.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton. Phytoplankton populations in the Atchafalaya River are generally sparse. The principal group consists of diatoms, with the most common genera being *Melosira*, *Cyclotella*, and *Navicula*, with lesser numbers of green algae and desmids. Zooplankton is comprised of numerous species of rotifers, with copepods, cladocerans such as *Daphnia* and *Bosmina*, and other groups being less abundant. Construction during the fall months has the most chance of harming the plankton community. (The period least harmful to plankton with regard to disruption of the river environment would be June through August.) However, the plankton community is extremely adaptive due to its rapid and massive reproduction potential. The relatively short duration of the individual discharges associated with revetment construction and the small volume of water that would contain greater than normal suspended particulate loads indicate that effects of the discharge on plankton associations would be negligible.

(2) Effects on Benthos. The natural steep or bluff banks of the Atchafalaya River support small to large populations of benthic invertebrates depending on stability or rate of caving of the bank, and the sediment type. The clay plug and other stable deposits of sediments may support very productive populations. The characteristic and most abundant benthic species at most natural bank sites which would be affected by revetment work are burrowing larvae of the mayflies *Tortopus* and *Pentagenia*. Other common benthic organisms that occur at most natural bank sites include the amphipod *Gammarus*, the pelecypod *Corbicula*, the oligochaete *Limnodrilus*, and the chironomid *Polypedilum*. Caddisfly larvae may also be abundant on tree limbs and similar submerged substrate. Benthic organisms are absent or very sparse in the generally coarse, shifting bed load sediments of the main channel. Grading and paving of the bank with revetment materials result in destruction of the natural habitat and the associated benthic community.

Recolonization of the revetted bank by indigenous bank dwelling species would occur on sediments accreted on the ACM and on the natural bank sediments beneath the ACM where buckling occurs and in the interstices between the blocks comprising the mat. Some epibenthic organisms such as leeches or caddisflies would colonize the ACM mat; however, these organisms would probably be sparsely distributed. Recolonization of available substrate would be rapid because of the constant source of benthic organisms. On the whole, diversity of the benthos would be less on a revetted versus natural bank. For a single revetment this diversity loss would not be significant, though from an overall project viewpoint a reorganization of the ecological network would be expected.

(3) Effects on Nekton. The main river channel and natural banks support an abundant and diverse fauna of typical river fishes such as flathead, blue and channel catfish, buffalo, carp, bass, crappie and drum, plus gar, shiners and minnows. It is not expected that the disposal of graded bank material in the river adjacent to the bank would adversely affect fish populations because of the short duration of the bank grading operation at any particular site, the fact that fish would temporarily move from the immediate disposal area, the relatively small area of the expected turbidity plume and the adaptation of most river fishes to high turbidity and suspended sediment concentrations. Changes in water quality such as decreased dissolved oxygen which might occur at the construction site would be avoided by nekton. Toxic effects of the discharge are not anticipated.

(4) Effects on Aquatic Food Web. Since detritus comprises the basis of the energy system in the Atchafalaya River, no significant adverse effects on the aquatic food web should occur.

(5) Special Aquatic Sites.

(a) No wildlife sanctuaries or refuges, mud flats, vegetated shallows or riffle and pool complexes would be adversely affected by the revetment construction activity.

(b) Wetlands. In the project area late successional hardwoods and cypress-tupelo forest types located along the river bank are listed as special case wetlands by EPA (Federal Register Vol. 45, No. 208, page 70565) and, consequentially, could be classified as wetland types subject to Section 404 jurisdiction. However, since no dredged or fill material would be placed in forested wetlands as a result of revetment construction, no evaluations of the wetlands under Section 404 are required. In the jurisdictional area of the United States District Court for the Western District of Louisiana, including this portion of the Atchafalaya River, the court ruled that the clearing of bottomland hardwood forests using bulldozers and similar equipment constitutes the discharge of dredged material into the waters of the United States. Therefore, the clearing of vegetation from the top bank using bulldozers during revetment construction could be subject to Section 404. Approximately 24 miles of revetment remain to be installed on the Atchafalaya River during the remaining 18-year authorized construction period, or an average of 1.3 miles per year. Typically, an area up to 150 feet landward of the top bank would be cleared of vegetation during bank grading. A total of 250 acres for the 23.9 miles of revetment to be constructed on the Atchafalaya, or approximately 10.5 acres per year of forested wetlands, would be permanently destroyed by the revetment construction. This loss due to the revetment construction program is considered insignificant. Approximately the same area would be destroyed by bank caving if revetment were not constructed.

(6) Threatened and Endangered Species. No threatened or endangered species or their critical habitat would be adversely affected by revetment construction and bank stabilization measures. A complete discussion of endangered and threatened species is contained in Appendix H.

(7) Other Wildlife. The loss of natural streambank habitat as a result of revetment construction is not considered significant since this habitat would be lost over time by bank caving if revetments were not constructed. The area that is cleared and allowed to revegetate would provide browse for deer while in its younger stages.

(8) Actions to Minimize Impacts. There are no practical measures that could be taken to minimize impacts.

f. Proposed Disposal Site Determinations.

(1) Mixing zones for suspended sediments were calculated using average annual values of stream flow and suspended sediment concentrations at Simmesport. Results are summarized in Table G-11-3. The mixing zone required to dissipate the discharge of graded bank to a level of 1.25 times the average ambient concentration of suspended sediment requires a maximum of 9 water surface acres in September to a minimum of 1.1 water surface acres in December. This amount is not considered ecologically significant.

(2) Compliance with Applicable Quality Standards. Louisiana numerical water quality standards for the portion of the Atchafalaya River in which revetment construction will take place are:

Chloride	65 mg/l
Sulfate	70 mg/l
Dissolved oxygen	5.0 mg/l
pH range	6.5 to 8.5
Temperature	33°C
Total dissolved solids	440 mg/l

The bacterial standard applied to this river reach is for Primary Contact Recreation, the highest water use category. Based on not less than five samples taken in a 30-day period, fecal coliforms are not to exceed a logarithmic mean of 200 colonies/100 ml, nor are more than 10 percent of total samples taken in any 30-day period to exceed 400

TABLE G-11-3

MIXING ZONE CHARACTERISTICS DEGRADING OPERATION,
ATCHAFALAYA RIVER REVETMENT CONSTRUCTION

Parameter/Month	August	September	October	November	December
Average Flow (cfs)	110,000	87,000	92,000	104,000	147,000
Average Suspended Sediment (mg/l)	237.6	219.2	297.6	297.1	426.8
1.25 x Average Suspended Sediment (mg/l)	297.0	274.0	372.0	371.4	533.5
Flow Required to dilute Discharge to 1.25 Average Suspended Sediment (cfs)	25,235	27,357	20,144	20,173	14,042
Percent of total flow Required for Dilution	23	32	22	19	10
Width of Front Edge of Mixing Zone (ft)	337	365	269	269	187
Length of Mixing Zone (ft)	1,358	1,540	840	893	293
Total Affected Water Surface (acres)	7.6	9	4	4.3	1.1
Time of Transport Through Mixing Zone (minutes)	15	17	9.3	9.9	3.3
Ratio of Width of Mixing Zone to Average River Width	.176	.191	.14	.14	.098
$\bar{x}$ Daily Suspended Sediment Load (thousands of tons)	3548.4	2900	2967.7	3466.7	4741.9
Percent of $\bar{x}$ Daily Suspended Sediment Load Degraded, per day	3.8	4.7	4.6	3.9	2.9

colonies/100 ml. In addition to these standards, general criteria dealing with esthetics; color; floating, suspended and settleable solids; taste and odor; toxic substances; oil and grease; foaming or frothing material; nutrients; and turbidity are applicable to the Atchafalaya River.

The only category of toxic substances determined to be applicable to dredged material pursuant to Section 307 of the Clean Water Act of 1977 is polychlorinated biphenyls. This class of chemicals has been detected in the Atchafalaya River, but not in the reach subject to bank stabilization.

Based on available water quality data, the alluvial nature of the soils, the inert character of revetment construction materials, mixing zone and elutriate test data available, and the short duration of the construction work period at any particular site, applicable water quality standards would not be exceeded, nor would any ephemeral increases in water column chemical constituents associated with revetment construction be considered ecologically significant.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supply. No effect, since there are no water intakes downstream of revetment sites.

(b) Recreational and Commercial Fisheries. No effect.

(c) Water Related Recreation. A minor temporary effect would be expected.

(d) Esthetics. No significant adverse effects are expected on the river with the exception of the time of construction activity at any given site. Although ACM and stone on a recently revetted bank differs greatly from its natural appearance, most revetment ultimately becomes vegetated and assumes a natural aura.

(e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites and Similar Preserves. A complete discussion of cultural resources is found in Appendix E. At the present time, no properties listed in the National Register of Historic Places or Historic Sites are located in the construction zone. The principal jeopardy to any unknown site in the immediate construction area or between the levees is bank caving, which the bank stabilization program is designed to prevent. Specifications for revetment construction require that any item of historical or archeological interest which may be discovered be reported to proper athorities and that work cease until the items can be classified. No national seashores, wilderness areas, research sites or similar preserves are located at the revetment sites.

(f) Determination of Cumulative Effects on the Aquatic Ecosystem. The construction of revetment works would result in a general reduction of bank caving rates and resultant introduction of sediments to the river. There would be a net loss of natural bank habitat for benthos and fish populations. At the time of project completion 50-percent of the river banks in this reach would be permanently altered. The main channel would tend to deepen. Overall species diversity would decrease as bankline conditions become more uniform.

On the Mississippi River reach from Old River to the Arkansas River, installation of revetment is directly associated with a 92 percent reduction in bank caving in the 40-year period since the revetment construction program was initiated. Similar data do not exist for the Atchafalaya River; however, bank caving should also be significantly reduced through the construction period. Currently bank caving rates in the Atchafalaya River average 25-feet per year on cutting banks. The likely effects of the reductions would be a slight decrease in turbidity and increase in water clarity with corresponding positive effects on aquatic biota. The overall effects of the short term grading of soils at an average of 1.3 miles per year for the life of the project are not considered ecologically significant. The total average annual volume of dredged material generated by bank grading is approximately 650,000 cubic yards, or about 0.9-percent of the total annual suspended sediment discharge of the river (average discharge period of record October 1975 through September 1977). The average bank grading operation would increase the total daily suspended sediment load of the river by approximately 4.7-percent in September to 2.9-percent in December. Table G-11-3 lists percent increase, by month, for the August to December construction period.

Any reduction in benthic production may adversely affect fishery production since most of the common river fishes are bottom feeders during at least some portion of their life cycle. Long term reduction in sediment input to the river as a result of bank stabilization and associated decreases in turbidity could, however, increase the potential for primary production during summer and fall low-flow periods.

(g) Determination of Secondary Effects on the Aquatic Ecosystem. Secondary effects of greatest concern are the possibilities of development induced by the project. As a result of bank stabilization some new development might occur near Simmesport and the West Atchafalaya Basin Floodway. Depending on the type of development additional impacts on the environment might be expected.However, existing or recommended easements for the remainder of the project reach would serve to minimize secondary effects.

III. Findings of Compliance for Revetment Construction, Bank Stabilization, Mainstem Atchafalaya River (River Miles 1.0-55.0 and River Mile 115).

a. No significant adaptations of the guidelines were made relative to this evaluation.

b. The following are less environmentally damaging alternative disposal sites that were considered for disposal of bank grading material. These alternatives would require the use of pipeline hydraulic dredges, hopper dredges, and/or land-based draglines.

(1) Placement of material from bank grading on flood plain behind the top bank was considered. This alternative would eliminate significant sediment input to the river from bank grading and would create elevated mounds of dredged material that would be of limited value as wildlife habitat, especially during floods. However, this disposal site alternative would require the additional clearing of approximately 1,000 to 1,500 acres of woodlands during the remaining revetment construction period. This disposal method would require new bank grading equipment and modification of existing equipment at tremendous costs. Most of the existing grading plant would become obsolete. Also, the bank grading rate (linear feet per day) would be slowed, resulting in substantially increased costs and delays in revetment work that would have adverse effects on bank stability and eroded sediment inputs.

(2) Placement of soil from bank grading on cleared flood plain lands between the top of the bank and the levee was considered. This alternative would have considerable advantages from an ecological standpoint. However, transporting of material to these locations, requirements for new bank grading equipment, and loss of efficiency would severely limit the revetment construction program and greatly increase costs.

(3) Placement of soil from bank grading on cleared lands on the landside of the levee was considered. This alternative would have similar advantages to those of alternative 2. Disadvantages would also be similar to those of alternative 2 but of greater magnitude.

(4) Placement of soils from bank grading in river channel areas of low velocity was considered. This disposal site alternative would decrease the rate of sediment loading to the river channel. However, major new equipment outlays and modification of existing plant would be required, and efficiency and speed of bank grading would be reduced, thereby significantly increasing costs. In addition, locations having reduced current velocities in the river tend to be the most biologically productive habitats. Therefore, it is concluded that the proposed site for graded bank soils is the most practicable alternative considering a balance of both economic and environmental considerations.

c. There are no alternative sites for placement of revetment materials. In order to be effective for bank stabilization and channel alinement, the revetment must be located in the areas where banks are caving and the structure must extend from the top of bank elevation down the bank slope to the thalweg.

d. Use of the proposed disposal sites would not violate any applicable State Water Quality Standards and would comply with applicable toxic effluent standards or prohibitions under Section 307 of the Clean Water Act. Turbidity might rise significantly above ambient levels, but would not be expected to impact a large portion of the channel cross-section. There is no evidence of violations of applicable State of Louisiana water quality standards that would be associated with revetment construction.

e. Use of the selected disposal sites would not harm any endangered species or their critical habitat or violate protective measures for Marine Sanctuaries.

f. The proposed disposal of dredged material would not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic life and other wildlife would not be significantly affected. There would be a cumulative effect due to the permanent alteration of half of the area's natural bottom habitat. Net significant adverse affects on aquatic ecosystem diversity, productivity and stability, and recreational, esthetic and economic values would not occur.

g. Appropriate steps to minimize potential adverse impacts of the discharge on aquatic ecosystems include the placement of filter material along the water line to minimize erosion from wavewash during construction.

h. On the basis of the guidelines, the proposed disposal site for the discharge of dredged material is specified as complying with the requirements of these guidelines with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the affected aquatic ecosystem.

Channel Training above Morgan City Outlet Flow Distribution

I. Project Description

a. Location. This evaluation addresses impacts of two major features of the Atchafalaya Basin Floodway project: channel training of the Atchafalaya River above Morgan City, Louisiana, between river miles 90 and 116 (all mileage described is in 1963 river miles); and control of outlet flow distribution. Also included is an evaluation of possible minor bank maintenance which may be required along the main channel from above mile 53 to mile 90.

b. General Description. The Atchafalaya River is formed near Simmesport, Louisiana, where Old River and Red River meet. The river then flows about 140 miles to Atchafalaya Bay, an arm of the Gulf of Mexico. The Atchafalaya River is the major distributary of the Mississippi River, and the basin through which it flows serves as a major floodway during times of high flow.

The Atchafalaya Basin Floodway consists of three separate floodways: the West Atchafalaya and Morganza Floodways to the north, and the Lower Atchafalaya Basin Floodway to the south. The Lower Atchafalaya Basin Floodway begins about the latitude of Krotz Springs and extends southward to the vicinity of Morgan City. The Atchafalaya River in the area of proposed channel training varies from a well-defined main channel between about mile 55 and mile 95, to a somewhat braided channel between mile 95 and mile 116 as the river flow passes through the Grand and Sixmile Lake areas.

More detailed descriptions of the project area are in Section 5 of the Environmental Impact Statement (EIS) and in the Technical Appendixes, especially Appendix A. Plate 1 is a General Map of the area.

c. Authority and Purpose. Channel training above Morgan City and outlet distribution control are authorized by the Flood Control Act of 15 May 1928, Public Law 391-70, as amended. As a part of the overall plan for the Atchafalaya Basin Floodway System, the post-authorization study was authorized by the discretionary authority of the Chief of Engineers by letter dated 18 June 1976. This letter directed development of alternative plans to accomplish the authorized purposes of the Atchafalaya Basin Floodway project.

The purposes of channel training above Morgan City are to accelerate development of a main channel through the lower floodway and to prevent further sedimentation adjacent to this reach, which results in loss of floodway capacity. The majority of the works would be below mile 94 and would confine flow to the main channel. Material dredged from the channel would be deposited in low bank areas and gaps to prevent overflow during low to moderate flow periods. Low back levees would prevent runoff of sediment into adjacent areas. Minor bank maintenance along the main channel might be required above mile 90 to prevent crevassing of existing banks. The purpose of the outlet work would be to maintain an approximate distribution of outlet flows of 70 percent via the Lower Atchafalaya River and 30 percent via the Wax Lake Outlet. Results would be monitored to determine the feasibility of changing the flow distribution to 80/20, provided the flood control capacity and ecosystem responded favorably. This control would be effected by the building of a stone weir and connecting levees upstream from Wax Lake Outlet.

d. General Description of Dredged or Fill Material. The channel training material would be dredged from the main channel and placed along the channel banks. The approximate ratio of sand to silt would be 3:1 and about 29 million cubic yards would be required. For outlet controls the weir would be built of stone and the levees of clay. The top 50 feet of soil in the vicinity of the connecting levees is composed of fat clays having a soft to medium consistency. The estimated quantity of fill required for levee construction is 250,000 cubic yards. The material would be taken from a borrow pit south of the levee.

e. Description of the Proposed Discharge Sites.

(1) Location and Size. Plate 9 shows the general location of the proposed channel training works. The presently estimated location of those works is given in Table G-11-4 and indicated on Plate 10. In this rapidly changing area, other disposal sites might be utilized and some shown on Plate 10 may be deleted. Thus, this evaluation will cover any and all channel training works necessary between miles 90 and 116. In a worst case situation, approximately 5,500 acres would be utilized for disposal. Plate 10 also indicates the location of the weir and levees that would control outlet distribution. It can be seen that from mile 101 to mile 106 the channel training works and outlet control levees would be coincident and run along the middle of Cypress Island. Gaps would be left in the channel training works at approximately miles 106 and 113 to allow some flow through in the Berwick/Morgan Island area.

(2) Types of Sites. The dredged material would be placed in confined disposal areas along the banks of the river to simulate natural ridges. These ridges would be constructed to a height equal to the average annual flood, or about 5 to 7 feet National Geodetic Vertical Datum (NGVD) and would be approximately 1,000 feet in width. Above mile 90, material would be placed as required to prevent or repair crevasses in existing banks. The Wax Lake Outlet control levees would be built to be overtopped by a flood occurring once every 10 years on the average. These levees would have a crown elevation of 10 feet, a 20-foot crown width, 1V:4H side slopes and berms, and would slant across Cypress Island to tie in with the West Atchafalaya

TABLE G-11-4

CHANNEL TRAINING

Location (1963 Mileage)	Descending Bank	Channel Enlargement (sf)
93.7-96.0	Right	6,000
96.8-100.5	Right	12,000
101.0-101.5	Left	4,000
101.5-102.0	Left and Right	8,000 (total)
102.8-104.0	Right	4,000
104.0-105.5	Left and Right	10,000 (total)
105.5-107.0	Left	5,000
107.0-107.8	Right	4,000
107.8-108.4	Left and Right	7,000 (total)
108.4-110.4	Left and Right	7,000 (total)
113.5-116.0	Left	8,000

Basin protection levee. The two-stage stone weir at the head of Cypress Island would be overtopped at all times.

(3) Types of Habitat. Between river miles 90 and 116, discharge of dredged material would occur in three habitat types: cypress-tupelo, early successional bottomland hardwoods, and open water. Approximate acreages affected are: 400 acres of cypress-tupelo, and 4,950 acres of early successional bottomland hardwoods (primarily willow flats). The amount of shallow open water that would be used for disposal is not accurately known at this stage of design, but would probably be in the range of 200 acres. Above mile 90, minor bank maintenance might be required, but acreage affected would be small. If work is required in this reach, primarily the bottomland hardwood habitats would be the type affected. For outlet distribution control not coincident with channel training, approximately 26 acres of early successional bottomland hardwoods would have dredged material deposited on them.

(4) Timing and Duration of Discharge. Work would be accomplished primarily during average to low flow conditions. Channel training construction activity from mile 90 to mile 116 would extend over several years. The possibility of minor bank stabilization work above mile 90 would exist for the project life. The outlet control work could extend over 2 years.

f. Description of Disposal Method. Hydraulic dredging would be used for the channel training work. The levees would be built by casting dredged material from the adjacent borrow pits. The weir would be constructed of riprap from commercial producers outside the area.

II. Factual Determinations

a. Physical Substrate Determinations.

(1) Substrate Elevation and Slope. Existing elevations in the wetland and terrestrial disposal sites vary from 0 to 2 feet NGVD to 10 to 15 feet NGVD. Disposal for channel training would create simulated natural ridges not less than 5 to 7 feet NGVD that would confine moderate and low flows to the main channel. Initially, these banks would be overtopped an average of once in 2 years. As natural levee formation progresses, overtopping would occur less frequently. The open water disposal would generally occur in areas less than 20 feet in depth, except in some passes which may be deeper. Disposal for outlet control would create a levee approximately 10 feet high that would regulate low to moderate flows into Wax Lake Outlet. The control weir would be overtopped at all flows.

(2) Sediment Type. The dredged material for channel training would be primarily sand with some silt which would be similar to sediment in the disposal areas, with the exception that it would contain less organic material. Soils from both dredging and disposal sites are of alluvial origin. Soils in the cypress-tupelo disposal areas could be slightly finer than the dredged material. The dredged material forming the levee would be mostly fat clay and would be similar to the clay in the disposal area.

(3) Dredged/Fill Material Movement. The channel training dredged material would be confined and the effluent returned to the main channel through controlled spill gates. Effluent discharge rates and suspended solid concentrations would be dependent on: elevation, height, and length of outlet weirs, surface area and geometry of containment sites, rates of discharge into sites, and distance from the end of the discharge pipe to the outflow location. Some movement of dredged material from the channel training sites may occur during high flows, but overall deposition of sediment in off-channel areas would be reduced. Any dredged material that is eroded from the levee would generally return to the adjacent borrow pit. It would be physically compatible with those sediments.

(4) Physical Effects on Benthos. Benthic organisms at the disposal sites for the channel training and outlet work would be destroyed by burial, although only the open water and cypress-tupelo habitats support resident populations. Such swamps are the most productive benthic habitat in the basin. Seasonal use of the bottomland hardwood habitats within disposal sites by benthic organisms would be precluded or reduced. Subaqueous benthos would be destroyed at the dredging sites. In addition, removal of organic material from the channel would reduce both food sources and substrate diversity. Loss of bank vegetation would reduce the amount of detritus added to the river system.

(5) Other Effects. Widening and deepening the channel would tend to increase the constantly changing nature of the substrate. Widening would increase the fine particle levels and might encourage sporadic deposition by reducing velocities and particle carrying capacity. Existing vegetation in the channel training disposal sites would be destroyed, but would revegetate over time to early successional bottomland hardwoods. Most cypress-tupelo habitats would be lost. Kinds and numbers of animals using the disposal sites would be dependent on the successional stage of the vegetation in the areas. The levees for the outlet flow control would not revegetate with forest but remain open land.

(6) Actions Taken to Minimize Impacts. The channel training alternative is the least environmentally damaging of the alternatives that would accomplish project purposes. The discharge would be confined to the smallest practicable area, and the effluent returned to

the main channel to preclude possible adverse impacts in off-channel areas. Natural revegetation of the disposal areas would occur within 1 to 2 years. The channel training works on the right descending bank would be coincident with the outlet control levee for at least five miles. It is possible that the outlet levee would be coincident with the channel training works from mile 101 to mile 108.5. This would shorten the levee length by approximately 1 mile, but would mean that the ten-foot high levee would be 8.2 miles in length instead of seven miles. The final alinement would be determined by environmental and engineering considerations.

b. Water Circulation, Fluctuation, and Salinity Determinations.

(1) Water.

(a) Salinity. No effect from channel training. Control of the outlets could reduce flows out Wax Lake Outlet to 20-percent which could somewhat deter the freshening trend in East and West Cote Blanche Bays.

(b) Water Chemistry. The waters of the Lower Atchafalaya River can be generally characterized as turbid (the mean value for suspended solids is 237 mg/l), slightly alkaline (pH 7.5), moderately oxygenated (50-100 percent of saturation), and nutrient-rich. Effluent from the channel training disposal areas and runoff from the levee would contain higher concentrations of suspended solids than the receiving waters. Dissolved oxygen would also be reduced, at least initially. However, these effects would be localized and of little significance. Secondary effects of the channel training work and levee construction would be to reduce overflow into off-channel wetlands and water bodies in the Berwick/Morgan Island area. Sedimentation in this area would be reduced, which would prolong its existence as wetland and aquatic habitat. Turbidity would be decreased under moderate to low flow conditions, with a resultant increase in primary production. Temperatures may be somewhat higher during periods when the amount of colder river water entering this area is reduced. Algal activity should increase, but effects on most water quality parameters should be insignificant. Channel training and outlet control should have no significant affect on pH in the river or the adjacent areas.

(c) Clarity. Water clarity would be increased in areas protected from direct river overflow by channel training and/or the levee. No measurable effect would occur in the main channel except in localized areas during dredging and drainage of effluent.

(d) Color. No significant effect.

(e) Odor. No significant effect.

(f) Taste. No significant effect.

(g) Dissolved Gas Levels. Effluent from initial disposal operations would likely be low in dissolved oxygen from contact and mixing with organic material in the dredging and disposal sites. Effects would be localized and temporary as the main channel receiving waters generally contain adequate oxygen levels. However, input of large organic loads to the channel could incur large oxygen demand, especially when construction occurs during low flow periods. The Berwick/Morgan Island area would have decreased turbidity and higher primary production than at present. Therefore, dissolved oxygen may be reduced in these areas during periods following high biological activity.

(h) Nutrients. The effluent draining into the river may be higher in nutrients than the receiving waters, however, any effects on nutrient levels would be localized and temporary. Nutrient levels in these areas along the main channel partially isolated from river overflow by channel training and/or the levee might be reduced since riverine waters in the Atchafalaya Basin are a primary source of nitrogen and phosphorus. However, nutrient levels in these areas would not likely fall below levels which are limiting to biological productivity. Within the main channel nutrient levels would increase dramatically due to construction activities, then decrease dramatically as the detrital sources are reduced. Gradually, nutrient levels would return to near normal as the flood plain area revegetates.

(i) Eutrophication. There should be no significant effects due to naturally high turbidity.

(2) Current Patterns and Flow. The objective of channel training is to confine moderate to low flows within the main channel. This confinement would not affect water levels in off-channel areas to the north since they also receive water from other sources, but would reduce inflow of generally more turbid, more oxygenated, and more nutrient-rich water. Changes in current patterns would occur in these areas, especially as various distributaries became blocked. The Berwick/Morgan Island area would receive reduced river flows at low to moderate water levels and thus circulation would be impeded at those times. The outlet control feature might eventually reduce the percentage of flow through the Wax Lake Outlet to 20 percent. This could change current patterns in Atchafalaya Bay.

(a) Velocity. During moderate to low flows water velocity would be decreased in off-channel areas, especially in the Berwick/Morgan Island area. Velocities in the main channel would tend to increase, but this effect would be tempered by the increased cross-sectional areas. Velocities would become much more uniform with areas of high and low velocities disappearing. If the outlet control feature reduces flows in Wax Lake Outlet to 20 percent, velocities would slightly decrease in Wax Lake Outlet and increase in the Lower Atchafalaya River.

(b) Stratification. No effects.

(c) Hydrologic Regime. The channel training works would accelerate main channel development by confining most flows to the main channel. This would reduce frequency of overbank flows into off-channel areas along the main channel, especially in the Berwick/Morgan Island area, and thereby reduce sedimentation in these areas. The basic hydrologic changes would be more flow in the main channel and less flow in other areas along the main channel. Water levels in off-channel areas would not be significantly affected, however, as these areas receive water (ground or surface) from other sources. The trend would be toward higher water levels in these areas as the region continues to subside. The outlet control feature would maintain present percentages of flow at the outlets at first. If the percentage via Wax Lake Outlet were later reduced to 20, there would be no further development of its channel, but development of the Lower Atchafalaya River would increase.

(3) Normal Water Level Fluctuations. During moderate to low flow conditions the channel training works and levee would prevent direct river flow into off-channel aquatic habitats along the main channel, but water level fluctuations should not be significantly affected except, perhaps, in the Berwick/Morgan Island area. During high flow events the low ridges or levee would be overtopped and river water would flow directly into and through the off-channel areas. Overall sedimentation rates and turbidity in the off-channel areas would be reduced, and dissolved oxygen may be lowered, primarily during the summer and early fall. The weir would slightly affect normal water level fluctuations along Wax Lake Outlet.

(4) Salinity Gradients. Since control of the outlets to 70/30 would slightly reduce the percentage of flow via Wax Lake Outlet at low flows, the marshes and bays to the east of the Lower Atchafalaya River would become fresher while the marshes and bays west of Wax Lake Outlet would become more brackish. These trends would be intensified if the outlets were controlled to a 80/20 distribution.

(5) Actions That Will be Taken to Minimize Impacts. The selected channel training alternative is the least environmentally damaging alternative that would accomplish project purposes, and would result in reduced sedimentation in off-channel habitats. Presently, this sedimentation is resulting in the conversion of aquatic habitat to sandbar and willow flat habitat, and is reducing the flood capacity of the floodway. The disposal areas would be confined to the smallest size practicable, and the effluent returned to the main channel where its effects would be minimal. Also, during detailed design further consideration would be given to measures that would provide for increased circulation in selected off-channel aquatic habitats. There would be no action taken to minimize impacts to water circulation and salinity caused by the outlet flow distribution feature.

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Sites. The Lower Atchafalaya River and Wax Lake Outlet are turbid and have high concentrations of suspended sediments. The dredged material from channel training is predominately sand with some silt, and would be placed in confined areas to keep lateral movement and filling of aquatic and terrestrial habitat to a minimum. The effluent from the confined disposal areas would be returned to the main channel and should not increase suspended particulates or turbidity above ambient levels except in the immediate discharge area. Impacts at the dredging sites would be long term. Dredging for channel training would occur over a period of several years. The material utilized to build the levees would be clay and some runoff would be expected. During construction localized increases in suspended particulates and turbidity would be expected. After dredging is finished at each site sediment discharge would decrease, however, higher than normal levels would be expected while the channel adjusts to its new flow regime. Deposition would increase slightly in the delta region during the construction and adjustment periods. It would remain at higher than present rates as the project would direct sediment to the delta rather than the flood plain. In off channel areas particulate loads would decrease on an annual basis.

(2) Effects on Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Turbidity and suspended solids levels are naturally high in the Atchafalaya River Main Channel. Therefore, although particulate levels would be elevated due to channel alterations and readjustment, little noticeable effect would be expected. In off-channel areas light penetration should increase due to being cut off from the main channel. Construction of the stone weir flow distribution structure should have negligible effects on water column light penetration. The composition of core material collected in the vicinity of the proposed connecting levees of this feature ha been estimated to be 31 percent sand, 35 percent silt, and 34 percent clay. Construction of the levees would present opportunities for sediment loss with temporarily increased suspended solids and turbidity levels and consequent temporarily reduced light penetration in adjacent water bodies and wetlands.

(b) Dissolved Oxygen. The mean COD of 14 core material samples collected in 1976 from the Atchafalaya River Main Channel and adjacent overbank areas was about 21,800 mg/kg (43.6 pounds of COD per ton of solids). Consequently, the COD to be satisfied in the Atchafalaya River Main Channel waters might, on average, be increased by about 44 pounds for each ton of solids lost during material excavation. This figure does not include the COD of bottom sediment interstitial waters released to the water column during dredging.

Because the Atchafalaya River Main Channel has a relatively large dilution capacity, the additional demand on oxygen resources caused by channel training and outlet flow distribution work should not be of much consequence. However, the COD of low DO effluents released from dredged material containment areas may cause DO depression in adjacent shallow wetlands. The severity of DO depression in these shallow waters would depend upon the quantity and quality of the discharged effluents.

(c) Toxic Metals and Organics. The amount of suspended sediment carried by the Atchafalaya River is dependent on streamflow, turbulence, sediment particle size, water temperature, and sediment availability. Commonly more than 90 percent of the contaminant load is associated with suspended sediment, thus keeping dissolved contaminant concentrations low. Suspended sediment discharges at Simmesport at the head of the project area show that an average of 108 million tons of total suspended sediment flows through the project area annually. Approximately 23-percent is composed of sand and 77-percent silt. The annual average suspended solids concentration is 550 mg/l. During the construction season, August through December, suspended solids range from a low of about 55 mg/l to a high near 550 mg/l, with the concentration dependent upon streamflow, turbulence and availability of sediments. The dredging operation to enlarge the channel is not expected to significantly increase contaminants in river waters. Elutriate tests indicate that few highly toxic substances in sediments would become available to aquatic life at harmful levels. With the lack of significant industrial, municipal or agricultural drainage areas in this reach of the Atchafalaya River, river bed materials are expected to be relatively free of contaminants. Table G-11-5 displays results of a single sample analysis completed in 1981 at river mile 110. This sample did not detect the introduction of any toxics, other than copper, due to mixing sediments with river water. However, detection limits above the criteria level did not allow positive determinations for some substances.

(d) Pathogens. Since there is no municipal sewage outfall within several miles of these features, an increase in pathogens due to dredging is unlikely.

(e) Esthetics. The increased turbidity caused by dredging would not be noticeable except in localized areas for a short duration.

(3) Effects on Biota.

(a) Primary Production, Photosynthesis. Primary production in large, turbid alluvial rivers like the Atchafalaya is low, with most of the system's food supply coming from outside the river in the form of organic detritus. Covering more than 5,000 acres of cypress-tupelo and bottomland hardwoods with dredged material from channel training and outlet distribution control works would

TABLE G-11-5

WATER AND SEDIMENT DATA
SITE NO. 17, 1981
ATCHAFALAYA RIVER, MILE 110

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Total Solids, % by Wgt					78.3
Total Volatile Solids					0.20
Turbidity	29,000				
Suspended Solids	43,200				
Volatile Suspended Solids	12,900				
Oil and Grease					428
Chlorides	30,000				
COD	11,000	9,000	17,000		8,520
TKN	610		560		8.20
Cyanide	< 10		< 10	3.5	
Phenols	< 10		< 10	2,600	
Nitrite-N	36		20		< 0.20
Nitrate-N	1,580		1,770		< 0.20
Total Nitrogen-N	2,230		2,350		8.20
Ammonia-N	28		51	20**	0.612
OrthoPhosphate-P	83	28	43		1.31
Total Phosphorus-P	140	100	150		248
Calcium	39,100	36,800	37,900		
Magnesium	11,100	11,100	11,000		
Manganese	76	1	19		103
Iron	1,970	38	< 25	1,000	3,810
Mercury	< 0.2	< 0.2	< 0.2	0.20	< 0.10
Lead	4	1	1	3.8*	29.5
Zinc	< 25	< 25	< 25	47	13.5
Chromium	2	< 1	< 1	0.29	3.88
Cadmium	0.5	0.5	< 0.1	0.025*	0.53
Copper	5	4	6	5.6	0.55
Nickel	< 1	< 1	< 1	96*	8.74
Arsenic	1	1	1	40	1.25

* Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.
**Criterion is for un-ionized ammonia, which would comprise about 1 percent of total ammonia at anticipated pH and temperature conditions.

temporarily remove a significant source of detrital energy from the lower Atchafalaya ecosystem, but revegetation with early successional bottomland hardwoods would occur rapidly. The aquatic primary production in the cypress-tupelo habitats would be lost. Reducing river overflow to off-channel aquatic habitats, especially the Berwick/Morgan Island levee, would result in reduced turbidity and an increase in potential for primary production and photosynthesis in these areas. Also, reduction in sedimentation would prolong the productive lives of these aquatic habitats.

(b) Suspension/Filter Feeders. Riverine habitats in the Atchafalaya Basin generally support sparse benthic populations compared to other aquatic habitats. For example, the mean number of benthic organisms per square meter in riverine areas was found to be 327, as compared to 1,840 in headwater lakes, 3,292 in bayous, and 3,768 in swamps. Tubificid worms, chironomids, and Asiatic clams are commonly found in riverine habitats. Initially, these organisms would be lost at the dredging sites, but recolonization would eventually occur. In disposal sites, the loss of cypress-tupelo habitat (which supports the largest number of benthic organisms) would result in the reduction of populations of amphipods, clams, dipteran larvae, snails, and isopods. The bottomland hardwoods that are used as disposal areas for channel training and outlet control works would no longer be available for colonization by benthos at low and moderate flows. These areas would be wet only during high flow events.

(c) Sight Feeders. No appreciable effects on sight feeders should occur in the vicinity of dredging operations. About 400 acres of cypress-tupelo swamps, which support sight feeders such as largemouth bass, bowfin, shad, warmouth, and crappie, would be lost. Use of other terrestrial habitats in the disposal areas by sight feeders during moderate to low flows would be eliminated. Reduction of turbidity in off-channel areas would result in improved conditions for sight feeders in those aquatic habitats.

(4) Actions Taken to Minimize Impacts. See section II.a(6).

d. Contaminant Determinations. The material proposed for discharge is similar to that in the disposal sites, and contaminant levels are generally low (see Table G-11-5). The proposed discharges should not significantly introduce, relocate, or increase contaminants. Since no significant contamination would be expected, no further testing of sediments was done.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton. Plankton populations in the Atchafalaya River and Wax Lake Outlet consist mainly of diatoms, desmids, rotifers, cladocerans, and copepods. No group is abundant. No significant effects would occur on plankton in the main channel. Plankton populations in disposal areas, primarily confined to the

cypress-tupelo habitats, would be lost. Reduced turbidity in off-channel areas may benefit some plankton species, but overall effects should not be significant.

(2) Effects on Benthos. See Section II.a.(4) and II.c.(3)(b).

(3) Effects on Nekton. There would be no significant effects in the main channel or Wax Lake Outlet. Fish populations in cypress-tupelo habitats in disposal areas would be lost, and use of other habitats in disposal areas by fishes would be greatly reduced. Reduced sedimentation and turbidity in off-channel aquatic habitat, especially the Berwick/Morgan Island area, should be beneficial to many species of fish such as bass, crappie, and bluegill.

(4) Effects on Aquatic Food Web. Loss of over 5,000 acres of vegetated aquatic and terrestrial habitat would reduce detrital material available for processing and use in the aquatic food web. However, in light of the total amount of aquatic habitat available in the project area, the effect is not considered significant. Some shift in kinds and numbers of aquatic organisms would likely occur in off-channel areas as they become more lentic or lake-like in character.

(5) Special Aquatic Site Effects.

(a) Wildlife Management Areas. All channel training works above mile 96 and those between miles 96 and 101 on the left descending bank are in the Attakapas Wildlife Management Area. The disposal would destroy existing forested areas, but would reduce sedimentation in the off-channel areas.

(b) Wetlands. As noted earlier, for purposes of this evaluation, all habitats found in the proposed disposal areas (cypress-tupelo, mid-to-late successional bottomland hardwoods, and early successional bottomland hardwoods) are considered wetlands. The proposed discharge would destroy existing vegetation and plant succession would begin within a year. The disposal area would become early successional bottomland hardwoods prior to 2030. Wetland values of the disposal areas would be reduced due to loss of cypress-tupelo habitat and the reduced flooding effected by the channel training works and levees. Wetland values of off-channel aquatic habitats will be enhanced and preserved in many instances due to reduction of sedimentation and turbidity. The overall effects, considering the vast acreages of wetland and aquatic habitat in the basin, would be minor.

(c) Mudflats. There could be, by the time of construction, some unvegetated mudflats in the area affected by channel training or outlet flow control. These flats would arise by sedimentation in this dynamic riverine system. They would be covered by disposal of dredged material. This impact would not be significant because of other mudflat areas available nearby.

(6) Threatened and Endangered Species. No significant effects. See Appendix H and Section 6, paragraph 6.287 of the EIS for detailed discussion.

(7) Other Wildlife. The proposed discharge would result in the immediate loss of over 5,000 acres of terrestrial wildlife habitat, including approximately 400 acres of cypress-tupelo, and 4,950 acres of early successional bottomland hardwoods. All disposal areas except the levees should revegetate with early successional bottomland hardwoods. The mid-to-late successional bottomland hardwoods provide the best wildlife habitat in the basin, with an abundance of soft and hard mast-producing trees, a diverse woody understory, and abundant herbaceous groundcover. Early successional bottomland hardwoods of the type found in the proposed discharge sites (primarily young, dense stands of willow) do not represent a quality habitat for most species of wildlife, but are heavily used by certain seasonally abundant species such as the yellow-rumped warbler or by white-tailed deer when basin water levels are low. The cypress-tupelo swamp habitats are primarily utilized by wildlife species that are water-oriented at some stage of their life cycle, such as, furbearers, herons, egrets, ibises, and wood ducks. They are less productive overall than the more mature bottomland hardwoods, but more productive than the early successional bottomland hardwoods.

(8) Actions to Minimize Impacts. All effluent from the channel training works would be returned to the main channel. Discharge would be confined to the smallest practicable area. Should the outlet distribution levee be made coincident with the channel training works for the longer distance, wetland loss might be further minimized.

f. Proposed Disposal Site Determinations.

(1) Mixing Zone Determination. The mixing zone will be the localized area in the vicinity of the construction works and the effluent from the confined disposal sites which discharges into the main channel of the Lower Atchafalaya River.

(a) Depth of Water at Disposal Site. Depth of water for disposal of material will range from less than 1 foot to generally not greater than 10 feet. Where effluent from disposal sites is discharged back into the main channel water depths will generally be less than 10 feet. Water depth at the weir site is several feet deep.

(b) Current Velocity, Direction, and Variability at the Disposal Site. Current velocities will generally range from 1 to 5 feet per second. Flow direction is downstream, although some eddy currents are present. Since the work would be done during moderate to low flow conditions, variability would be moderate.

(c) Degree of Turbulence. The Lower Atchafalaya River is naturally turbulent. Disposal of dredged material would increase turbulence in localized areas, but would also reduce overflow and turbulence in off-channel areas. Discharge of effluent into the main channel would not have significant effects.

(d) Stratification. No effects.

(e) Rate of Discharge. Discharge would be by hydraulic dredge for the channel training works and by bucket dredge for the levee. Rate of discharge would be in the general range of 500 to 1,000 cubic yards of dredged material per hour.

(f) Ambient Concentration of Constituents of Interest. Ambient suspended sediment concentrations in the Lower Atchafalaya River are high and average about 250 mg/l. Nutrients are fairly high, heavy metals and pesticides are low. Results from a single sample taken at river mile 110 are shown in Table G-11-5.

(g) Dredged Material Characteristics. See paragraph I.d.

(h) Number of Discharge Actions Per Unit of Time. Dredging would occur primarily during the summer and fall months (moderate to low flow conditions) and would extend over several years for channel training and over approximately two years for outlet control. The rate of discharge would depend on the size of dredge and operating conditions, but would be in the general range of 500 to 1,000 cubic yards of dredged material per hour.

(2) Determination of Compliance with Applicable Water Quality Standards. The Louisiana State Water Quality Standards for this reach of the Atchafalaya River (headwaters to Mile 118) are shown in Table G-11-6.

Additional State of Louisiana non-numerical criteria and standards are listed in Table G-11-6A.

The disposal of dredged material would cause some increases in turbidity and decreases in dissolved oxygen, but these would be localized and temporary. The material from channel training would be placed in confined sites. The effluent would be returned to the main channel of the Atchafalaya River. Soil, water, and elutriate analyses conducted in the Sixmile Lake area indicate the materials to be dredged are relatively free of contaminants. Thus, based on available water quality data, the nature of the receiving waters, the mixing zone and the elutriate test data, it does not appear that applicable water quality standards would be exceeded, nor would any temporary

TABLE G-11-6
NUMERICAL WATER QUALITY CRITERIA
LOUISIANA DEPARTMENT OF NATURAL RESOURCES

SEGMENT DESCRIPTION	WATER USES[1/] A	B	C	D	CL	SO4	DO	PH RANGE	BAC STD[2/]	TEMP	TDS
Atchafalaya River - Headwaters (Barbre Landing) to mile 118 (1.2 miles below mouth of Bayou Boeuf) (includes Grand Lake and Sixmile Lake)	X	X	X	X	65	70	5.0	6.5 TO 8.5	1	33	440
West Atchafalaya Borrow Pit Canal (St. Landry and St. Martin Parishes)	X	X	X		100	75	5.0	6.0 TO 8.5	1	32	500
Atchafalaya River - mile 118 to Atchafalaya Bay (Tidal)	X	X	X		N/A	N/A	4.0	6.5 TO 9.0	1	35	N/A
Intracoastal Waterway (North-South) - Bayou Sorrel to Morgan City		X	X		80	75	5.0	6.0 TO 8.5	2	32	500
Intracoastal Waterway (East-West) - Bayou Boeuf Locks to Wax Lake Outlet		X	X		150	75	5.0	6.0 to 8.5	2	32	500
Wax Lake Outlet (Tidal)		X	X		N/A	N/A	4.0	6.5 TO 9.0	2	35	N/A
Atchafalaya Bay (Tidal)		X	X		N/A	N/A	5.0	6.5 to 9.0	4	35	N/A

1/ A = Primary contact recreation
B = Secondary contact recreation
C = Propagation of fish and wildlife
D = Domestic Water Supply

2/ #1 PRIMARY CONTACT RECREATION - Based on a minimum of not less than 5 samples taken over not more than a 30-day period, the fecal coliform content shall not exceed a log mean of 200/100ml. nor shall more than 10 percent of the total samples during any 30-day period exceed 400/100ml.

#2 SECONDARY CONTACT RECREATION - Based on a minimum of not less than 5 samples taken over not more than a 30-day period, the fecal coliform content shall not exceed a log mean of 1,000/100ml. nor shall more than 10 percent of the total samples during any 30-day period equal or exceed 2,000/100ml.

#3 PUBLIC WATER SUPPLY - The monthly arithmetic average of total coliform MPN (most probable number) shall not exceed 10,000/100ml. nor shall the monthly arithmetic average of fecal coliforms exceed 2,000/100ml.

#4 SHELLFISH PROPAGATION - The monthly total coliform median MPN (most probable number) shall not exceed 70 per 100ml. and not more than 10 percent of the samples ordinarily exceed an MPN of 230/100ml.

TABLE G-11-6A
QUALITATIVE WATER QUALITY CRITERIA
LOUISIANA DEPARTMENT OF NATURAL RESOURCES

PARAMETER	CRITERIA (Summarized as applicable)
ESTHETICS	Waters shall be maintained in an aesthetically attractive condition and shall be free from discharges sufficient to result in objectional color, odor, taste, and turbidity, or to injure animals or plants, or to produce undesirable aquatic life.
COLOR; FLOATING, SUSPENDED, SETTLEABLE SOLIDS; and TURBIDITY	True color shall not be increased to the extent that it would interfere with present or projected usage. Increased color, in combination with turbidity, shall not reduce the depth of the photosynthesis compensation point more than 10 percent from the seasonally established norm. There shall be no substantial increase in ambient turbidity due to waste discharge.
TASTE and ODOR	Production of potable water by reasonable treatment methods shall not be interfered with. No unpalatable flavor shall be imparted to food fish or shellfish, nor shall offensive odors arise from waters.
TOXIC SUBSTANCES	These shall not be present alone or in combination in quantities that would be toxic to animal or plant life. In all cases the level shall not exceed the Median Tolerance Limit (TL_m) 96/10.
NUTRIENTS	The naturally occurring nitrogen-phosphorus ratio shall be maintained.
OIL and GREASE	These shall not be present in quantities that interfere with designated uses.

increase in water column chemical constituents associated with channel training or outlet control works be considered ecologically significant.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supply. There would be no effects since there are no municipal water intakes within, or downstream of, the construction area.

(b) Recreational and Commercial Fisheries. See Section II.c.(3). The loss of about 5,550 acres of aquatic and seasonally flooded terrestrial habitat would adversely affect recreational and commercial fisheries to an unknown, but probably minor, degree. The disposal areas would revegetate and furnish organic detritus to the aquatic food web, however, they would be flooded less frequently than they are presently. These areas would be used by aquatic and semi-aquatic animals during high water periods. The recreational and commercial fisheries in the off-channel areas, especially in the Berwick/Morgan Island area, would be improved somewhat as a result of reduced sedimentation and would remain aquatic habitat for a longer period of time. Overall effects, considering the type and quantity of aquatic habitat in the basin and the rapidly changing (from aquatic to terrestrial) character of the areas proposed for disposal sites, are not significant.

(c) Water Related Recreation. Some small passes used by recreational boaters would be closed to navigation, although water access to most areas would still be available by other routes. Major passes to recreational waters, such as American Pass, would not be modified.

(d) Esthetics. Disposal areas would be unsightly until revegetation occurs. Loss of some 400 acres of esthetically pleasing cypress-tupelo habitat would occur. The increased turbidity during construction would be unpleasing, but this effect is minor and temporary. Reduced turbidity and sedimentation in some off-channel aquatic habitats would be beneficial to esthetics in those areas.

(e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. There would be no effects on any such areas.

f. Determination of Cumulative Effects on the Aquatic Ecosystem. The channel training works above Morgan City are part of an overall comprehensive plan for the Atchafalaya Basin Floodway System. The plan would accomplish flood control objectives, which are of great importance in the Lower Mississippi Valley, and provide for preservation and enhancement of the very significant fish, wildlife, and other natural resources of the basin. Overall, then, the plan would result in preservation and enhancement of significant portions of the basin's aquatic environment, especially through environmental easements. The plan cannot, however, prevent large-scale changes in habitat, from aquatic to terrestrial, as the maturation of the Atchafalaya River continues. The total direct construction impacts of this entire project would result in the loss or modification of approximately 6,000 acres of cypress-tupelo, 9,000 acres of mid-to-late successional bottomland, and 6,000 acres of early successional bottomland hardwoods. This compares to approximately 451,000, 332,000, and about 100,000 acres, respectively, of these habitat types within the project-affected area (Table 6-7, page EIS-110, Volume 1). On a percentage basis, construction of the entire project would cause a respective loss of 1.3, 2.7, and 6.0 percent, of these habitat types.

The terrestrial habitat loss caused by the two features considered in this 404(b)(1) Evaluation would be an even smaller percentage of the total loss. The loss of open water habitat caused by these features would also be small in comparison to the acreage available, but exact figures are not obtainable. The open water areas to be filled are primarily small shallow passes with relatively swift currents and shifting sand substrates, and as such generally provide poor aquatic habitat.

Channel enlargement between mile 90 and 116 would eliminate the diversity of subaqueous conditions in that reach. A uniform channel would have more uniform bank habitat, flow patterns, temperature gradients, and flood stages. Shifting bed loads, areas of scouring and deposition, and increased particulate loads would be expected to continue to exist. These occurances would inhibit normal aquatic growth. The delta area at the river mouth would aggrade slightly more rapidly than present with fine sand and silt layers. Increased channel capacity would reduce overflow and use of the floodplain as a source of organic nutrients and detritus. Runoff from adjacent areas might increase which could decrease the amount of water available to sustain base flow during dry conditions.

Thus, disposal of dredged or fill material as part of the overall plan for the Atchafalaya Basin Floodway System would add to the cumulative loss of habitat in Louisiana, but this amount of loss and/or conversion of habitats is acceptable in the overall public interest.

g. Determination of Secondary Effects on the Aquatic Ecosystem. Secondary impacts on the aquatic ecosystem include the 50 acres of early successional bottomland hardwoods and 10 acres of cypress-tupelo that would be utilized as borrow areas for these two features. Other secondary impacts such as confinement of river flows from river mile 90 to 116 and reduction of sedimentation in off-channel areas have been discussed previously. The channel training would aid in preservation of the Upper Belle River area. The channel training on the north bank is a feature of this possible management unit and its construction would reduce sedimentation into the unit even without construction of other works. The weir at the head of Wax Lake Outlet would have very little impact on bed load transport. If the distribution of flows were changed to 80/20 in the future, less sediment would flow down Wax Lake Outlet and the delta there would develop more slowly and the delta below the Lower Atchafalaya would prograde more quickly. The additional growth of the delta would contribute to some small degree to the increased flooding in the backwater area east of Morgan City.

III. Finding of Compliance for Channel Training above Morgan City and Outlet Flow Distribution.

a. No significant adaptions of the guidelines were made relative to this evaluation.

b. There are no alternative sites which would accomplish the objectives of the channel training and have less adverse impact on the aquatic ecosystem. The size of sites would be kept to the minimum and effluent from the confined sites would be returned to the main channel where effects on the aquatic ecosystem would be minimal. Closure of potential or actual crevasses above mile 90 can only be made at those sites and the overall effect of such actions, if needed, would be to reduce degradation of backwater aquatic ecosystems as a result of sedimentation. There is no practicable alternative site for the weir in Wax Lake Outlet that would have less adverse impact on the aquatic ecosystem. An alternative alinement exists for the levee and it will be investigated further at later stages of the project.

c. Use of the proposed disposal sites would not violate state water quality standards to a significant degree. There would be some associated increases in turbidity and decreases in dissolved oxygen, but these would be localized and temporary.

d. Discharge would comply with applicable toxic effluent standards and prohibitions under Section 307 of the Clean Water Act.

e. The proposed discharge would not jeopardize the continued existence of any threatened or endangered species nor result in the destruction or adverse modification of critical habitat.

f. The Marine Protection, Research and Sanctuaries Act of 1972 would not apply.

g. The proposed discharge would not result in unacceptable adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fisheries, plankton, fish, shellfish, wildlife, or special aquatic sites. The discharge would likewise not result in unacceptable adverse effects on life stages of aquatic or semi-aquatic organisms, aquatic ecosystem diversity, productivity, and stability, or recreational, esthetic, and economic values.

h. Appropriate and practicable steps to minimize potential adverse impacts of the discharge on aquatic systems include confinement of sites to smallest practicable area, return of the effluent to main channel, and consideration of the alternate alinement for the levee.

i. On the basis of the guidelines, the proposed disposal sites for the discharge of dredged material are specified as complying with the requirements of the guidelines with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the affected aquatic ecosystems.

Widening Wax Lake Outlet

I. PROJECT DESCRIPTION.

a. Location. This evaluation addresses the impact of constructing a new levee approximately 3 miles to the west of the Wax Lake Outlet (WLO) channel. This project feature is the part of the Atchafalaya Basin Floodway Project referred to as: Widening Wax Lake Outlet. The new levee would begin northeast of Shadyside, Louisiana, and run southwest across Bayou Teche ridge and old US Highway 90, continue past the Southern Pacific Railroad and new US Highway 90 to the Bayou Sale ridge, then parallel the ridge and existing levee southward to the Gulf Intracoastal Waterway (GIWW). Degrading the existing levee located adjacent to the Wax Lake Outlet and GIWW would be part of this work item (see Plate G-11).

b. General Description. The Atchafalaya River is formed near Simmesport, Louisiana, where Old River and Red River meet. The river then flows about 140 miles to Atchafalaya Bay, an arm of the Gulf of Mexico. The Atchafalaya River is the major distributary of the Mississippi River, and the basin through which it flows serves as a major floodway during times of high flow. The Atchafalaya Basin Floodway consists of three separate floodways: the West Atchafalaya and Morganza Floodways to the north, and the Lower Atchafalaya Basin Floodway to the south. The Lower Atchafalaya Basin Floodway begins about the latitude of Krotz Springs and extends southward to the vicinity of Morgan City.

(1) The Lower Atchafalaya River, with a design capacity of 1,200,000 cubic feet per second (cfs), is the natural outlet to the Gulf of Mexico for the Atchafalaya Basin. It begins just below Morgan City at the confluence of Berwick Bay and Bayou Shaffer and runs southward to Atchafalaya Bay, an approximate distance of 20 miles.

(2) The Wax Lake Outlet, with a capacity of 300,000 cfs, was constructed in 1941 to supplement the outlet capacity of the Lower Atchafalaya River. This dredged channel, located about 10 miles west of Berwick, extends from Sixmile Lake through the Teche Ridge and Wax Lake into Atchafalaya Bay, a distance of about 16 miles. The channel, constructed to a bottom width of 300 feet from Sixmile Lake to a point 0.5 mile below Bayou Teche and to a bottom width of 400 feet below that point, has a uniform depth of 45 feet below National Geodetic Vertical Datum (NGVD). By constructing a new levee approximately 3 miles back from the outlet channel and degrading the existing levee the area for overbank flooding would be increased.

(3) The distribution of flow during a project flood would change from 80/20 to about 55/45. The project flood flowline could be

(2) Sizes, Types of Habitat and Type of Sites. The new levee would occupy approximately 300 acres of cypress-tupelo wetland. The existing levee is 130 acres in extent; it would be degraded and spread over approximately 570 acres of late successional bottomland hardwoods, which are considered wetlands. It is possible that some of this material could be placed in existing borrow pits. All disposal would be classified as unconfined.

(3) Timing and Duration of Discharge. The construction of the new levee and degradation of the old levee would take approximately one year.

(4) Description of Disposal Method. Draglines would probably be used to both build the new levee sections and degrade the old levee.

II. FACTUAL DETERMINATIONS.

a. Physical Substrate Determinations. Substrate along the route of the new levee would be mainly natural levee and marsh deposits. Substrate under the degraded levee would be mainly marsh and natural levee deposits with some backswamp deposits (see Plate G-8). Effects on:

(1) Substrate Elevation and Slope. The new levee sections would vary in elevation and slope. Current plans call for elevations from 18.7 feet NGVD near Shadyside, Louisiana, to a low of 9 feet NGVD at the GIWW. The 7.4 mile reach of the levee across the cypress-tupelo swamp would be 14.7 feet NGVD. Slopes would range from 1 on 4 to 1 on 5. The old levee would be degraded to near ground level and zero slope.

(2) Sediment Types. The new levee material would be essentially the same as that in adjacent land areas and borrow pits, therefore no significant change in substrate characteristics would result from erosion of embankment materials. The degradation of the existing levee would represent an alteration of substrate character, but placing the material in thin layers would allow gradual restoration to occur.

(3) Dredged/Fill Material Movement. Small amounts of dredged material used for the new WLO levee construction would be eroded from the embankments and would generally return to its original location (borrow area). Degraded levee material would continue to erode until it became approximately level. Some would enter Wax Lake Outlet, the GIWW, and existing borrow pits as the overbank flooded. Degradation of the existing Wax Lake Outlet levee could result in a sizeable material handling problem due to the nature and amount of material.

reduced as much as 3 feet for the West Atchafalaya Basin Protection Levee (WABPL) and East Atchafalaya Basin Protection Levee (EABPL). More detailed descriptions of the project area and features are in Section 5 of the Environmental Impact Statement (EIS) and in the Technical Appendixes, especially Appendix A. Plate 1 is a general map of the area. Plate G-11 illustrates the widening Wax Lake Outlet feature.

c. Authority and Purpose. The widening of Wax Lake Outlet is authorized by the Flood Control Act of 15 May 1928, Public Law 391-70, as amended. As a part of the overall plan for the Atchafalaya Basin Floodway System, the post-authorization study was authorized by the discretionary authority of the Chief of Engineers by letter dated 18 June 1976. This letter directed development of alternative plans to accomplish the authorized purposes of the Atchafalaya Basin Floodway project. The purpose of widening the Wax Lake Outlet overbank area is to achieve a greater flood carrying capacity in this area while protecting the natural environment. The result of this feature would be to return the additional overbank area to its more natural state of receiving tidal flows and intermittent high riverine flows.

d. General Description of Dredged or Fill Material. A new levee would be constructed to the west of the Wax Lake Outlet channel, beginning at approximately WABPL Station 5600. Relocation of old and new US Highway 90, the Southern Pacific Railroad, the West Calumet floodgate, a parish road, and various utility lines would also be required. A soil sample taken along the proposed levee alinement about 0.6 mile southwest of the railroad contained 45 percent sand, and 55 percent silt and clay. The new levee construction would require about 2.5 million cubic yards of fill material, while the levee degradation work would involve the disposal of about 1.7 million cubic yards. Quantities of earthwork required for the relocations have not been determined. Borrow material for the new levee would be dredged from adjacent landside and floodside borrow pits along most of the 8.9-mile alinement. The existing levee, extending from WABPL Station 5600 southward along WLO and westward along the GIWW, would be degraded to existing ground level. Detailed dredged and fill material handling procedures have not been formulated, but could include hauling some degraded levee material to other construction sites or borrow areas.

e. Description of Proposed Discharge Site(s).

(1) Location. The locations of the proposed levee and the levee to be degraded are shown on Plate G-11. The new overbank area south of the railroad is approximately 8,000 acres in extent, consisting of approximately 670 acres of open land, 600 acres of fresh marsh, 2,800 acres of late successional bottomland hardwoods, and 4,000 acres of cypress-tupelo swamps. North of the railroad there are approximately 1,000 acres of late successional bottomland hardwoods and 1,300 acres of open land.

(d) Color. Color would be affected in a similar manner to water clarity.

(e) Odor and Taste. No effects on water odor or taste would be expected as a result of implementing this project feature.

(f) Dissolved Gas Levels. The dissolved gas of major concern is oxygen. Oxygen levels are generally dependent on temperature in the wetland areas of the Atchafalaya. A full discussion on dissolved oxygen (DO) effects appears in Section II.c.(2).b.

(g) Nutrients. Nutrients in the WLO wetland areas are generally low. Primary production is dependent to a large degree on recycling of nutrients. Opening up a larger area for overbank flooding would increase the nutrients available to the overbank area on an annual basis. This increase would be expected to have a positive effect on the wetland areas. Nutrients produced in the newly opened overbank area could be exported to the marsh/estuarine area to the south.

(h) Eutrophication. Eutrophic conditions would not be expected as a result of levee building or degrading.

(2) Current Patterns and Circulation. Widening the WLO overbank area would increase the storage capacity of the floodplain; an additional 10,300 acres of land would be available for overbank flooding. During a project flood, widening the overbank area would allow Wax Lake Outlet to carry 45-percent of the flood instead of the 30 percent it can carry at present. The overbank would flood every other year on the average. The borrow pit dug during levee construction would change existing current patterns; it would allow drainage following floods and provide a possible route for tidal exchange.

(3) Normal Water Level Fluctuations. Widening the WLO overbank area would substantially increase water level fluctuations in the 10,300 acres that would be reconnected to riverine and tidal infuence. Flood stages along Wax Lake Outlet would be lower than present due to the increased size of the floodplain. Flow below bankfull stage would not be affected.

(4) Salinity Gradients. The increased overbank area would tend to lengthen the flood durations while decreasing flood peaks. These circumstances would moderate the salinity gradient fluctuations presently occurring downstream of this area during flood events. No effect would occur with discharges of bankfull or less.

(5) Actions That Will Be Taken to Minimize Impacts. Only the minimum amount of wetland necessary to complete project objectives would be impacted.

(4) Physical Effects on Benthos. Nearly all benthic organisms in the 300 acres of cypress-tupelo swamp filled by levee building would be destroyed by burial. No known collections have been made in these swamps, but they are highly productive. It can be assumed that benthic populations would be similar to those in the Atchafalaya Basin Floodway to the north. Species diversity should be high and crawfish, clams, fly larvae, isopods, and amphipods should be abundant. Benthos uses late successional bottomland hardwoods only on a temporary, seasonal basis. Covering 570 acres of this habitat with degraded levee would temporarily reduce future benthic use. As the widened overbank was overflowed by riverine waters, benthic productivity would be increased in those areas because they would probably be flooded longer than at present. If existing borrow pits were filled with degraded levee material, the existing benthos would be destroyed by burial.

(5) Other effects. All trees on the 300 acres of swamp where the levee would be built and on the 570 acres of woods that would have degraded levee spread on them would be destroyed. The former bottomland hardwood area would start to revegetate immediately and within 3 years would be early successional bottomland hardwoods, mostly willow. The swamp that was filled to build levee would no longer support plankton or fish. The bottomland hardwoods where the degraded levee was placed would receive reduced seasonal use by plankton and fish. Fish and plankton in any filled borrow pits would be destroyed.

(6) Actions to Minimize Impacts. Some of the material from the degraded levee along Wax Lake Outlet might be used to backfill some small and isolated borrow pits. Material from the levee north of the GIWW might be used to attempt to prevent bank erosion along this waterway. Dikes, seeding, and other practical measures would be employed to control erosion of levee materials into borrow pits, wetlands, or other water areas.

b. Water Circulation, Fluctuation and Salinity Determination.

(1) Effects on Water.

(a) Salinity. No effects on salinity would be expected due to this project.

(b) Water Chemistry. Alkalinity and pH would not be significantly affected by levee building or degrading due to the similarity of soils.

(c) Clarity. Water clarity in the surrounding waters and wetland areas would be significantly reduced temporarily. After the levee building or degrading operation, those areas remaining as wetlands would shortly return to near normal clarity. During storm events or flooding of the overbank area, additional temporary reductions in clarity would be expected until the disposal areas revegetated.

(e) Esthetics. During construction and degradation activities the spreading of the clay would degrade esthetics in the area until revegetation occurred. Post-construction esthetics would not be significantly reduced.

(3) Effects on Biota.

(a) Primary Production. Some primary productivity occurs in the cypress-tupelo swamps in the area; such productivity is probably lower than in the Atchafalaya Basin Floodway to the north because, at the present, these swamps do not receive riverine or tidal overflow, and thus are probably lower in nutrients. Diatoms, blue-green algae, and flagellates are probably common and population peaks would be expected in the summer. The turbidity engendered by levee construction would flow into the swamps adjacent to the borrow pit and temporarily reduce primary production until the levee becomes vegetated. The existing bottomland hardwoods are only seasonally flooded. Degrading the levee into such areas would temporarily reduce their potential to produce phytoplankton and benthic algae. However, as the widened overbank area is overflowed by nutrient-rich riverine waters, the 780 acres of early successional bottomland hardwoods, created because of levee degradation, would have higher primary productivity than the presently existing 130 acres of levee, 80 acres of farm land and 570 acres of woodlands. Turbidity from the degraded levee would, during construction, temporarily reduce primary productivity in the GIWW and Wax Lake Outlet.

(b) Suspension/Filter Feeders. Turbidity caused by building the new levee would affect clams, amphipods, and other filter feeders in the adjacent cypress-tupelo swamp. Turbidity engendered by degradation of the existing levee would enter Wax Lake Outlet, the GIWW, and borrow pits. If the levee was degraded during the time the nearby bottomland hardwoods were flooded, turbidity would affect the seasonal benthos there. However, all turbidity effects would occur only during construction and storm events. Effects should be of a minor nature. Once the overbank was widened, the extra nutrients and detritus carried in by the riverine waters would benefit filter feeders throughout the area.

(c) Sight feeders. The sight-feeding fish in the cypress-tupelo swamps (bowfish, shad, and crappie) would avoid the turbid area and should not be adversely affected. The catfish, striped mullet, shad, and buffalo fish that are present in the riverine waters of Wax Lake Outlet would also avoid the plume of turbidity. Once the overbank area is reconnected to the riverine system, fishery productivity would improve dramatically.

(4) Actions Taken to Minimize Impacts. See discussion in Sections II.a(6) and II.b(5).

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site. This project feature would require degradation and disposal of about 1.7 million cubic yards of existing levee material, excavation of about 2.5 million cubic yards of usable material for construction of a new levee, and an as yet unquantified amount of earthwork associated with road and utility relocations. Most of this work would be performed in shallow wetland areas affording many opportunities for sediment loss in water bodies. It is anticipated that suspended solids and turbidity levels would be temporarily increased as a result of the construction and degradation activities. Leaching of spread levee materials into wetlands not initially smothered would certainly occur, but the degree of impact is highly speculative. Suspended solids and turbidity levels should gradually return to near predisturbed levels after construction activities ceased.

(2) Effects on Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Light penetration would be temporarily reduced in the WLO area due to increased suspended solids and turbidity levels during levee building and degrading operations. Coarse solids, which would be resuspended in the water column during placement of levee material in wetlands, would settle from suspension in a relatively short period.

(b) Dissolved Oxygen. The oxygen demand of sediments resulting from levee degradation and construction in the WLO area would likely be significant. Intermittent and localized reductions in the DO content of the shallow bottomland hardwood and swamp waters would likely occur during construction of this feature. Normal DO levels in these areas are very dependent on temperature and flow conditions. At the present time the area receives no overflow from Wax Lake Outlet and is isolated from tidal exchange. The only circulation at present is the drainage of local rainfall into some areas. Widening the overbank area would allow increased circulation during high water events and on normal tidal cycles, thus increasing DO during those periods. However, flooding causes additional organic material to be deposited in the overbank area, which could reduce DO later as it decomposes. Overall, this project feature would be expected to have a positive effect on the DO quantities.

(c) Pathogens. No effects would be expected.

(d) Toxic Metals, Toxic Organics, and Biostimulants. One chemical sample was obtained from the proposed levee alinement. The analysis and implications of that sample are discussed in Section II. d. In general, toxic effects would not be expected.

TABLE G-11-7

WATER AND SEDIMENT DATA
SITE NO. 18, 1981
CANAL EAST OF BAYOU SALE RIDGE

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Total Solids, % by Wgt					30.0
Total Volatile Solids					2.28
Turbidity	5,900				
Suspended Solids	9,600				
Volatile Suspended Solids	2,000				
Oil and Grease					228
Chlorides	40,000				
COD	27,000	21,000	21,000		106,000
TKN	890		3,990		1,650
Cyanide	< 10		< 10	3.5	
Phenols	< 10		< 10	2,600	
Nitrite-N	< 10		< 10		< 0.20
Nitrate-N	12		33		< 0.20
Total Nitrogen-N	900		4,010		1,650
Ammonia-N	32		3,150	20**	106
OrthoPhosphate-P	60	19	< 10		0.814
Total Phosphorus-P	180	< 100	< 100		1,050
Calcium	25,000	26,200	44,300		
Magnesium	7,360	7,360	767		
Manganese	176	196	714		394
Iron	1,010	155	< 25	1,000	23,600
Mercury	< 0.2	< 0.2	< 0.2	0.20	< 0.10
Lead	2	< 1	< 1	3.8*	29.7
Zinc	< 25	< 25	< 25	47	108
Chromium	< 1	< 1	< 1	0.29	35.8
Cadmium	0.2	< 0.1	< 0.1	0.025*	0.50
Copper	< 1	3	< 1	5.6	29.2
Nickel	< 1	< 1	< 1	96*	34.8
Arsenic	3	2	4	40	6.62

* Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.
**Criterion is for un-ionized ammonia, which would comprise about 1 percent of total ammonia at anticipated pH and temperature conditions.

d. Contaminant determinations. Due to the lack of contaminant sources in the Atchafalaya area, high levels of toxic materials would not be expected. One sample taken from along the proposed levee alinement was analyzed. As table G-11-7 shows, cadmium, iron, and ammonia were actually detected above EPA freshwater aquatic life criteria levels. Of these only ammonia was implicated as being released by the operations necessary for levee building or degrading. The un-ionized fraction of ammonia is considered toxic to aquatic life. For the pH and temperature conditions at the time of sampling, about 1 percent of total ammonia or about 32 ug/l of un-ionized ammonia would be present, compared to the EPA criteria of 20 ug/l. Other parameters, including cyanide, chromium and cadmium, could not be measured down to EPA criteria levels, as was the case with most pesticides that were tested. Nevertheless, the available data and other information, including dredging methods and rates of discharge, do not indicate that significant ecosystem effects would occur.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton. Zooplankton populations in the cypress-tupelo swamps would consist mainly of ostracods and heavy genera of cladocerans, and copepods, while in the Wax Lake Outlet lighter weight cladocerans and copepods as well as rotifers would occur. Zooplankton occupying the 300 acres of swamp to be filled by the new levee would be destroyed, and some organisms in the immediately adjacent swamp could be destroyed or physically weakened by the turbidity. Degradation of the existing levee into 570 acres of bottomland hardwoods would temporarily reduce the potential of these woods to harbor zooplankton. However, as the widened overbank was flooded, the area would furnish more habitat for zooplankton than at present. The riverine waters overflowing the land would carry in a diverse zooplankton community, as well as nutrients and detritus. Under post-project conditions, the overbank area should have greater diversity and density of zooplankton. Effects on phytoplankton would be similar and are discussed in Section II.e.(3)(a).

(2) Effects on Benthos. See section IIa(4) and IIc(3)(b).

(3) Effects on Nekton. See section IIc(3)(c).

(4) Effects on Aquatic Food Web. There would be a small but permanent decrease in aquatic productivity associated with the filling of 300 acres of swamp for levee construction. The filling of 570 acres of bottomland hardwoods would cause a temporary decrease in productivity. However, the widening of the overbank area would reconnect over 7,000 acres of wetlands south of the railroad and nearly 1,000 acres of wetlands north of the railroad to the riverine/marsh/estuarine system. This should dramatically increase aquatic productivity in the area by augmenting the amounts of detritus

(chloride, sulfate, DO, pH, coliform bacteria, temperature, and total dissolved solids). (See Tables G-11-6 AND G-11-6A.) With the possible exception of DO none of these standards would be violated. In general, the proposed action would improve existing water quality conditions.

(3) Potential Effects of Human Use Characteristics.

(a) Municipal and Private Water Supply. No effects would be expected.

(b) Effects on Recreational and Commercial Fisheries. This project feature might improve the wetland areas in the WLO overbank, thereby benefiting recreational and commercial fisheries by improving spawning, nursery, and feeding areas.

(c) Effects on Water-Related Recreation. No significant effects would be expected.

(d) Esthetics. Degradation of the existing levee and construction of the new levee would cause temporary turbidity in adjacent areas which would reduce esthetic qualities. The degraded levee would be unsightly until revegetation occured.

(e) Effects on Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. None of these types of areas would be impacted by the proposed project feature. There might be unknown archeological sites within this area. Specifications covering the work to be performed in constructing and maintaining the levee would provide for the preservation of any items of apparent historical or archeological interest.

(f) Cumulative Impacts on the Aquatic Ecosystem. Widening the Wax Lake Outlet overbank is part of an overall comprehensive plan for the Atchafalaya Basin Floodway System. The plan would accomplish flood control objectives, which are of great importance in the Lower Mississippi Valley, and provide for preservation and enhancement of the significant fish, wildlife, and other natural resources of the basin. Overall then, the plan would result in preservation and enchancement of significant portions of the basin's aquatic environment, especially through environmental easements. The plan cannot, however, prevent large-scale changes in habitat, from aquatic to terrestrial, as the maturation of the Atchafalaya River continues. The total direct construction impacts of this entire project would result in the loss or modification of approximately 6,000 acres of cypress-tupelo, 9,000 acres of mid-to-late successional bottomland, and 6,000 acres of early successional bottomland hardwoods. This compares to approximately 451,000; 332,000; and 100,000 acres, respectively, of these habitat types within the project-affected area (Table 6-7, page EIS-110, Volume 1). On a percentage basis, construction of the entire project would cause a respective and nutrients carried in by way of riverine and tidal overflow. The additional flooding would also enlarge the acreage of flooded woodland, which would expand the area available for spawning, feeding, and growth of plankton, nekton, and crawfish and other benthos. Thus, the overall effect of this feature would be environmentally positive.

(5) Effects on Special Aquatic Sites-Wetlands. As noted earlier, for purposes of this evaluation, all woodland and marsh habitats in the proposed disposal areas are considered wetlands. Construction of the new levee would permanently destroy 300 acres of cypress-tupelo swamp. Degradation of the existing levee would destroy trees on 570 acres of bottomland hardwoods. However, these acres and the 210 acres of agricultural land covered during this process would revegetate with early successional bottomland hardwoods and again be considered wetlands. The overall affect of this feature would be to enhance wetland values throughout the overbank area.

(6) Effects on Wildlife. Construction of the new levee would replace 300 acres of cypress-tupelo swamp with 300 acres of levee. The swamp is primarily utilized by water-oriented wildlife, such as furbearers, wading birds and wood ducks. The levee would provide a place of refuge during high water for the more terrestrial wildlife that also uses the swamp. Degradation of the levee would replace 570 acres of late successional bottomland hardwoods with early successional bottomland hardwoods. The quality of these late successional hardwoods is moderate to poor; therefore, wildlife loss due to habitat change should not be significant. During construction and degradation some young or slow-moving animals would be killed. Others would move to adjacent areas where they might not survive due to overcrowding.

(7) Effects on Endangered or Threatened Species. There would be no significant effects on endangered or threatened species due to this feature. See Appendix H and Section 6, paragraph 6.287 of the FEIS for a detailed discussion.

(8) Action to Minimize Impacts. See sections II.a(6) and II.b(5).

f. Proposed Disposal Site Determinations.

(1) Mixing Zone Determinations. Mixing zone calculations are not applicable to wooded areas. Turbidity levels and leachate levels would increase in areas adjacent to levee embankment or degraded levee materials. These levels would decrease shortly after construction, but would increase intermittently during storm events. No unacceptable impacts would be expected.

(2) Determination of Compliance with Applicable Water Quality Standards. Water quality standards are established at the state level. Louisiana standards include a limited number of parameters which, in general, do not reflect industrial pollution

cause a noticeable rise in turbidity levels in the immediate vicinity of the work site. The levels would decrease soon after construction, but would increase intermittently during storm events. Since no numerical standards exist for turbidity or suspended sediment, a mixing zone could not be defined for these parameters. On a qualitative basis, no violations would be expected. There is no evidence from available data that any other regulated parameter would occupy a large enough portion of the water column to inhibit movements of free-swimming and drifting organisms. On the basis of available data, there would be no significant violations of applicable State of Louisiana water quality standards associated with implementation of this project feature.

d. No violations of the Toxic Effluent Standards of Section 307 of the Clean Water Act would be expected.

e. The proposed discharge would not jeopardize the continued existence of any threatened or endangered species nor result in the destruction or adverse modification of any critical habitat.

f. No designated marine sanctuaries are in the project area.

g. The proposed disposal of dredged material would not result in significant adverse effects on aspects of human health and welfare, such as: municipal and private water supplies, recreation and commercial fisheries, plankton, fish, shellfish, wildlife, and the above-mentioned special aquatic sites. There would be no significant adverse effects on life stages of aquatic animals or other wildlife dependent on aquatic ecosystems. Significant adverse effects on aquatic ecosystem diversity, productivity, and stability would not occur. Recreational, esthetic, and economic values would not be adversely impacted in a significant manner. On the whole, environmental values would be enriched.

h. Appropriate and practical steps taken to minimize potential adverse impacts of the discharge of material into aquatic ecosystems include using only those areas of wetlands necessary for project completion. Acreage required for the degraded levee material might be reduced by hauling it to other locations. Increased flow into the overbank area would be attained by the project. Appropriate measures to limit erosion of levee materials into aquatic areas by runoff would be employed.

i. On the basis of the guidelines, the proposed disposal sites for the discharge of fill material are generally specified as complying with the requirements of these guidelines with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the affected aquatic ecosystem.

loss of 1.3, 2.7, and 6.0-percent of these habitat types. The terrestrial habitat loss caused by the feature considered in this 404(b)(1) Evaluation would be an even smaller percentage of the total loss. Thus, disposal of dredged or fill material as part of the overall plan for the Atchafalaya Basin Floodway System would add to the cumulative loss of habitat in Louisiana, but this amount of loss and/or conversion of habitats is acceptable in the overall public interest.

(g) Determination of Secondary Impacts. The major secondary impact of widening the Wax Lake Outlet overbank area would be the reconnection of the area to the riverine/marsh/estuarine system. The beneficial impacts of this action have been discussed in several previous sections. The most significant adverse impact would be the 300 acres of cypress-tupelo swamp that would be utilized for borrow. The trees on these acres would be destroyed as would any existing benthos. The newly created borrow pit would probably have lower benthic populations and diversity than the previously existing swamp. The passage of an increased percentage of floodwaters out Wax Lake Outlet would augment delta growth at its mouth. This would be beneficial because there is no navigation channel to be maintained (as there is at the mouth of the Lower Atchafalaya River) and thus, the delta would be able to grow undisturbed. As floodwaters entered the overbank area they would deposit sediments. Most of this deposition would be north of the Teche Ridge or adjacent to Wax Lake Outlet. It is likely that some trees would be killed by the blanket of sediment, but the number should not be significant because most trees, especially near Wax Lake Outlet, would be willows which can tolerate sedimentation.

III. FINDINGS OF COMPLIANCE FOR WIDENING OF WAX LAKE OUTLET OVERBANK.

a. No significant adaptations of the guidelines were necessary for this evaluation.

b. An early alternative to widening the Wax Lake Outlet overbank was to move the levee only 2 miles west, which would have destroyed forested wetlands. The selected alinement at the base of the Bayou Sale ridge reconnects the maximum amount of wetlands to the riverine/marsh/estuarine system. The feasibility of transporting a large portion of the degraded levee fill to other levee construction sites and/or existing borrow areas for final disposal should be explored. These uses should present fewer environmental problems than the spreading of levee fill over adjacent woodland areas. Little specific information has been developed concerning the relocated levee construction. It might become evident that departures from the construction and disposal methods now in use for the floodway levee alterations would be advisable in specific instances, particularly in the vicinity of railroad, highway, or waterway relocations.

c. The levee building and degrading operations would likely

Distributary Realinements

I. PROJECT DESCRIPTION.

a. Location. The Atchafalaya Basin main channel has four major distributary channels between river miles 50 and 80 (Splice Island Chute at river mile 72 acts as a distributary most of the time). Two of the channels distribute flows to the western floodway and two serve the eastern floodway. Their general locations are shown on Plate G-1 and their existing and proposed inlets are shown in more detail on Plates 12 and 13 of this document. The proposed inlets for two of the channels are the original distributary inlets that were filled several years ago. The existing primary diversion from the Atchafalaya River to the western floodway via the Old Atchafalaya River is located at river mile 55.0. Under the project, this inlet would be closed and replaced with a dredged channel beginning at mile 53.5 which would reconnect with the Old Atchafalaya River in a distance of 6,000 feet.

The other three distributary inlets would be similarly relocated as follows: the East Freshwater Distribution channel, from mile 71.0 to mile 68.0 (13,000 feet long); the West Access Channel from mile 77.0 to mile 74.0 (8,000 feet long); and the East Access Channel, from mile 78.5 to mile 77.5 (15,000 feet long). Table G-11-8 shows pertinent dimensions, and excavation and fill quantities for the four realined distributary channels and closure dams. Also shown are revetment quantities for erosion protection.

b. General Description. The distributary channels as presently alined have transported a large portion (up to 50 percent) of the bedload sediments, as well as suspended sediments, away from the main channel to the floodway areas. The new inlets as designed should significantly reduce the bedloads carried by the distributaries. The existing channels would be closed near their inlets, and each realined channel and main channel approach would be revetted for distances of 1,000 feet from the new inlet locations. The revetments would consist of articulated concrete mattresses (ACM) below the low water line, and stone paving from the low water line to top of bank. The actions that subject this feature to Section 404 are: (1) closure of channels; (2) disposal of excavated material in the Atchafalaya River main channel; (3) disposal on land at Old Atchafalaya River; and (4) revetment construction at all realinements.

c. Authority and Purpose. The Flood Control Act of 1928, as amended by subsequent authorization provides for various structural improvements in the Mississippi River and Tributaries system. Senate and House resolutions of 1972 authorized the development of a comprehensive plan for the preservation and management of the water and land resources of the Atchafalaya Basin. A post-authorization

TABLE G-11-8

CHANNEL REALINEMENT AND CLOSURE DATA

Distributary	Realinements: Length (feet)	Width (feet)	Bottom Elevation (ft NGVD)	Side Slopes	Excavation Required (cy)	Concrete Revetment Required (100 sf units)	Stone Paving Required (tons)
Old Atchafalaya River at WBPC	6,000	1,000 (top)	-15.0	1:3	3,500,000 +160,000*	6,800	13,000
West Access	8,000	60 (bottom)	-7.0	1:3	350,000 +80,000*	4,700	13,000
East Freshwater	13,000	105 (bottom)	-7.0	1:3	800,000 +90,000*	5,100	11,000
East Access	15,000	60 (bottom)	-7.0	1:3	650,000 +100,000*	5,300	11,000

Distributary	Closures: Length (feet)	Base Width (feet)	Bottom Elevation (ft NGVD)	Side Slopes	Fill Required (cy)
Old Atchafalaya River at WBPC	800	2,000	-15.0	1:30	860,000
West Access	250	1,100	-7.0	1:30	70,000
East Freshwater	250	1,200	-7.0	1:30	80,000
East Access	300	1,100	-7.0	1:30	90,000

* Represents bank grading required for main channel revetments.

study was authorized by the Chief of Engineers by letter dated 18 June 1976, and provided for the study to address, in specific terms, alternate plans to accomplish the authorized purposes of the Atchafalaya Basin Floodway project. The purposes of distributary realinements are to reduce floodway sediment deposition in order to more effectively contain the project flood, and concurrently to help preserve the unique environmental features and to extend the long-term productivity of the natural environment.

d. General Description of Dredged or Fill Material.

(1) General Characteristics of Material. At the Old Atchafalaya River site, the material is a silty clay, while at the other sites the composition varies from silty clay to sandy silt to clayey silt. One-inch diameter, 50-foot deep soil borings were taken in the Atchafalaya River main channel and adjacent overbank areas in 1976. Sieve and hydrometer analyses of the soil cores taken indicate the approximate material compositions to be as follows:

Area	% Sand	% Silt	% Clay
Old Atchafalaya River (new cut) and closure	11	26	63
East Freshwater Channel (new cut)	10-36	32-40	36-58
East and West Access Channels (new cuts) and Bayous Chene and Sorrel closures	13-36	40-49	24-38

A shallow sediment sample was taken from the site of the Old Atchafalaya River closure in 1981 (site 5). Its detailed grain size analysis is shown in Table G-11-9.

(2) Quantities of Material. The channel realinements would require excavation in the amounts of: 3,500,000 cy for the Old Atchafalaya River at Whiskey Bay Pilot Channel; 350,000 cy for the West Access Channel; 800,000 by for the East Freshwater Channel; and 650,000 cy for the East Access Channel. The quantity requirements for the closures are estimated as: 860,000 cy for the Old Atchafalaya River site; 70,000 cy for the West Access Channel; 80,000 cy for the East Freshwater Channel; and 90,000 cy for the East Access Channel. About 70,000 cy of shell would be needed for cofferdams at the closure sites. Revetment materials in the amounts of 48,000 tons of stone and 22,000 squares of ACM would be needed for bank protection. About 430,000 cy of material would be removed from main channel bank and channel slopes for preparation for revetment placement.

(3) Sources of Material. The material would be hydraulically excavated from the channel realinement routes. Sufficient portions of the dredged material from each realinement would be designated for use as fill for the respective closure dams. Shell or other suitable

TABLE G-11-9

SIEVE ANALYSIS AND GRAIN SIZE DISTRIBUTION, 1981, SITE 5

Weights (g)	Sieve Size or Number	Percent Finer
0.	No. 40	100.0
0.1	No. 50	99.9
0.8	No. 70	98.9
9.9	No. 100	86.9
23.0	No. 140	69.6
39.8	No. 200	47.4

Hydrometer

Rdgs	Temp	Size, mm	Percent Finer
13.0	24.5	0.05044	28.3
9.5	24.5	0.03687	20.9
7.1	24.5	0.02664	15.9
5.5	24.5	0.01395	12.5
4.9	24.5	0.00991	11.2
4.6	24.5	0.00703	10.6
3.8	24.5	0.00500	8.9
3.2	25.0	0.00351	7.8
3.0	23.5	0.00147	6.8

Total weight of sample - 75.6 g.

material from an outside source would probably be used to form temporary dikes that would limit water movements during closure dam construction. Stone and concrete for revetments would also be obtained from outside the project area. Material graded from the main channel bank slopes would be alluvial soils.

e. Descriptions of the Proposed Discharge Sites.

(1) Locations. Plates 12 and 13 show the channel realinement and closure dam locations for each distributary.

(2) Sizes. The designated land disposal area for the Old Atchafalaya River realinement is bounded on the west by the realined channel route and on the remaining sides by old levees. The area would occupy about 140 acres and 60 acres would be required for retaining dikes and setback of the West Atchafalaya River levee. The open-water disposal operations in the main channel would affect indeterminate acreages of river bottom. The four distributary closures would cover a total of approximately 60 acres. Revetments would also cover approximately 60 acres.

(3) Types of Sites. The Old Atchafalaya River disposal area would be completely confined by the levees and by a continuous dike along the east bank of the excavated channel. One or more weirs would be constructed along the dike to return clarified effluents to the excavated channel at acceptable suspended solids levels. The excess dredged materials from the other three realinements would be discharged directly into adjacent reaches of the main channel. Material graded from the main channel banks and channel slopes in advance of revetment placement would also be discharged directly to the adjacent channel. The four closure dams would be constructed by discharge of dredged realinement material directly into the existing distributary inlets.

(4) Types of Habitat. The confined disposal area adjacent to the Old Atchafalaya River realinement is late successional bottomland hardwood habitat. The open-water disposal areas, and revetment and closure sites constitute riverine habitats.

(5) Timing and Duration of Discharges. The dredging and disposal operations would probably be conducted during the late fall and winter months of nonflood years and should require periods varying from about 3 weeks at the West Access Channel site to about 20 weeks at the Old Atchafalaya River site.

f. Description of Disposal Method. All disposal actions from realinement excavations would be accomplished by pumping the hydraulically dredged material from channel excavations through pipelines to the disposal sites. The closure dams would be constructed concurrently with the final dredging phases for their respective realinements. Shell-filled cofferdams would be installed near the upstream and downstream limits of each closure site immediately prior to their construction. The sloping banks of the main channel would be graded by mechanical equipment (bulldozers and draglines) to an acceptable slope before placement of ACM below the waterline and a 10-inch layer of stone above the waterline. The graded material would be discharged directly to the channel by dragline.

II. FACTUAL DETERMINATIONS.

a. Physical Substrate Determinations.

(1) Effects on Substrate Elevation and Slope. Since dredged material from realinement excavations at the West Access, East Freshwater and East Access Channels would be disposed directly to the main channel, except for those portions used to make the existing channel closures, conditions would not be altered to a measurable degree. Some of the hydraulic effluent would become dispersed and resuspended in the water column and the remainder would settle and become part of the bedload. The average graded slope of the revetted main channel reaches would be 1 vertical on 5 horizontal. The closures would be built to the heights of existing banks during final stages of realinement dredging. The pumped hydraulic fill would be subject to erosion by currents during construction, and would result in significant amounts of deposition along the downstream channel bottoms, unless protective measures were taken. The channel bottoms occupying the closure sites would, of course, be permanently covered. The streambeds between each closure site and realined channel junction would undergo gradual shoaling because of the induced quiescent conditions. The realined channels would be expected to enlarge naturally to an extent during subsequent high water periods and would undergo intermittent substrate alterations as they become stabilized. The dredged material from the realinement at Old River would be disposed to a depth of 3 to 4 feet in an adjacent forested area bounded by levees. This material would constitute about one-half of the total excavated for the distributary realinements, and would remain essentially isolated from nearby water bodies. The dikes would be built to a height of 6 feet and the new west Atchafalaya River levee would be 36 feet NGVD. The revetted bank and channel slopes would be permanently changed to the design dimensions, except for accumulated sediments on ACM surfaces.

(2) Effects on Sediment Type. The disposed materials would, in each case, be very similar in physical composition to main channel and distributary channel substrate materials, and should quickly become assimilated into them. The bed materials downstream of the closures would shift somewhat toward smaller average particle sizes under with-project conditions. Revetted slopes would accumulate sediments in interstices and on surfaces with the passage of time.

(3) Effects on Dredged/Fill Material Movements. The prevailing channel currents at time of disposal would dictate the extent of lateral and longitudinal dispersion of clays and silts, and the settlement rates of sandy material. In the main channel, piped effluent would not be discharged at rates sufficiently high to permit appreciable accumulation of material near the point of discharge or elsewhere. During channel realinement excavation by hydraulic dredges, high rates of material movement would be expected near the cutterhead, but would be localized and would quickly subside during nondredging periods. The hydraulic fill closures would be characterized by turbidity plumes and downstream deposition induced by erosion and slumping of submerged embankment materials into the water column during construction in the absence of measures to minimize exposure to currents. The material graded from main channel banks into the channel in preparation for revetment placement would be slowly assimilated into the water column as bedload or suspended sediments. The degree to which material would become suspended and transported downstream would be a function of current velocity and turbulence, and the consolidation of the graded material. Only a minor fraction of the soil mass should become suspended under anticipated conditions.

(4) Physical Effects on Benthos. Riverine and distributary areas in the basin generally support sparse benthic populations (327 organisms/square meter compared to 3,292/square meter in bayous). Tubificid worms, chironomids, and Asiatic clams would be expected to be present. Distributary channel closures would bury benthos at the closure sites, and for some distance downstream if the hydraulic fill material was exposed to currents during construction. The original benthic populations at these sites would have been small, however. After construction, gradual recolonization of benthos would occur in the more quiescent downstream waters that would tend to favor larger and more diverse populations than before. Return of effluent from the diked disposal area would have little impact on benthos. Temporary benthic populations that might exist in the 200 acres of bottomland hardwoods would be destroyed by disposal. This would be a minor impact. Revetment construction in the main channel 1,000 feet upstream and downstream from each new inlet would destroy existing benthic populations on about 60 acres. In time, sparse epibenthic colonization would occur.

(5) Other Effects. All trees on the areas used for levees, dikes, revetments and disposal would be destroyed. The 140-acre disposal area would start to revegetate immediately and it would be classified as early successional bottomland hardwoods in 3 years. These trees that would have dredged or fill material placed on them are presently removed from the Atchafalaya Basin overflow system by existing levees. They would support essentially no fish or plankton populations.

(6) Actions to Minimize Impacts. The work would be timed so as to avoid high-water periods and also extreme low-water periods to provide good working conditions and to ensure that channel flows would be adequate to disperse the discharged effluents. Dikes or cofferdams constructed of shell or some other material of similar consistency should be placed upstream and downstream of each of the closure sites immediately before the addition of the pumped hydraulic fill. Thus, the exposures of unconsolidated clay particles to erosive currents would be minimized. Control of dredged material effluents from the realined Old Atchafalaya River inlet channel would be effected by the construction of a continuous dike with overflow weirs.

b. Water Circulation, Fluctuation and Salinity Determinations.

(1) Effects on Water.

(a) Salinity. The disposal site waters are not affected by salinity.

(b) Water Chemistry. The pH levels of disposal site waters (main channel) might be slightly affected by nutrients in dredged effluents. But high background turbidity and relatively large mixing volumes would not permit other than temporary and localized shifts in pH. Construction of distributary closures could exert positive pH shifts for some distance downstream until cessation of flows. Alkalinity increases could also be effected during closure construction, but should normalize soon thereafter.

(c) Clarity. Some reduction in light transmissivity would be expected with the discharge of dredged materials. Relative changes in the main channel, however, would probably be slight because of high ambient turbidity. Noticeable effects would probably be present downstream of closures throughout the construction period, and briefly, thereafter, without erosion-prevention measures.

(d) Color. No significant discoloration of disposal site waters would be expected, unless high concentrations of organic matter would be present in dredged material (not evidenced by chemical analyses of sediment and water samples).

(e) Odor. Objectionable odors should not occur in main channel waters, where turbidity and turbulence would inhibit algal growth. Odors should not be a problem downstream of closures, either, unless nutrient levels were persistently high in eroded sediments and temperatures were favorable for algal growth, which would not be the case during the construction period (winter).

(f) Taste. Temporarily entrained organic matter or other oxygen demanding materials could possibly impart a characteristic taste to the disposal site waters, but since no public or private water supplies are in the vicinity, no human effects would be expected.

(g) Dissolved Gas Levels. It is possible that dissolved oxygen problems could occur along the bottoms of the nearly 3-mile long portions of the East Freshwater Distribution Channel and West Access Channel that lie south of the new channel cuts. During low-water periods these areas could have little or no flow. No unusual concentrations of oxygen-demanding matter would be expected in the dredged materials, therefore, only temporary and localized oxygen deficits should occur.

(h) Nutrients. Although the disposed materials probably would contain moderate nutrient levels their discharges should not significantly affect the quality of main channel waters. Release potentials would be low at the anticipated background dissolved oxygen and pH levels. A somewhat greater potential for adverse effects would exist in the vicinity of unconfined closure construction, but induced pH changes and oxygen demands would not be persistent or widespread. Although total sediment transport through distributaries should be less under project conditions, nutrient transport would probably decrease only slightly, if at all.

(i) Eutrophication. The combination of conditions necessary for eutrophication would not exist during the disposal periods.

(2) Effects on Current Patterns and Circulation. The realinements would have the obvious effect of rerouting main channel flows. Average current velocities through the realined inlets would probably be somewhat lower, with less turbulence than under existing conditions. After construction, the realined channels would gradually stabilize through one or more annual cycles, becoming more hydraulically efficient in the process. Flow rates should be about the same as for existing conditions. The cut off portions of each distributary (between the closure and the entrance of the new channel) would have drastically reduced flows.

(3) Normal Water Level Fluctuations. No particular effects on water level fluctuations are expected in the long-term. Temporary variations from normal stages may occur during construction and for some time afterward, until the realined distributaries become stabilized.

(4) Salinity Gradients. The sites are not affected by salinity.

(5) Actions to Minimize Impacts. The disposal of dredged material directly into the main channel should have the least adverse water quality impact of the available and practicable methods for the three smaller distributary sites. The use of an adjacent land area partially surrounded by levees should likewise result in the least

water quality impact of the alternative disposal methods for the Old Atchafalaya River distributary site.

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Sites. The discharges of hydraulically dredged material into the main channel would produce areas of relatively high suspended solids, and noticeable turbidity plumes whose shapes and sizes would be a function of current velocities, channel shapes and sizes, dredge pipe solids concentrations, degrees of turbulence, and background suspended solids and turbidity levels. Main channel velocities and dilution capacities would be sufficient to reduce suspended matter to acceptable levels within reasonable distances downstream. The extent and significance of distributary channel turbidities and suspended matter concentrations downstream of closures during construction would be somewhat more difficult to estimate, but would be dependent upon the volumes and rates of replacement of hydraulic fill material at the closure sites, as well as channel geometry, currents, and turbulence (which would vary as construction progressed) and background turbidity and suspended solids levels. (As noted above, such impacts could be reduced or eliminated by means of barriers to flow during closure construction.)

(2) Effects on Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Reduced light penetration would be effected by increased solids and turbidity levels. Turbidity measurements are indicators of light-scattering effects of fine suspended particles. Since background turbidity would probably be high, relative changes in light penetration of main channel waters would probably be slight even near the point of discharge. More distinct changes in light penetration would be apparent downstream of the closure sites during their construction unless erosion-prevention measures were instituted. Up to a few weeks following construction, residual effects might be noticeable, but eventually light penetration below closures would become greater than would have been the case without the project. Light penetration in the realined channels would, of course, be lowered during the dredging period near the suction head of the dredge.

(b) Dissolved Oxygen. Oxygen-demanding constituents (chiefly organic) in disposed materials directly reduce dissolved oxygen in the adjacent water column. Dredged slurries commonly contain little or no oxygen at the end of the discharge line regardless, so oxygen deficits would be expected at and near the points of discharge into the main channel. The turbulence and relatively high flow rates of the receiving water body should, however, confine significant deficits to very limited areas. During the cooler months, when construction would probably occur, dissolved oxygen would be higher than the annual average. Some minor heating of the receiving water would be caused by absorption of sunlight by suspended particles introduced into the water column. This phenomenon, along with direct interference with reaeration processes caused by suspended particles, works to reduce dissolved oxygen in the water column. Oxygen depression in waters at and downstream of the closure sites would be more severe than in the main channel, in the absence of any measures to control erosion of newly-placed hydraulic fill. Dissolved oxygen problems could occur after construction in the portions of the distributary channels between the closures and the new channels, especially at low water.

(c) Toxic Metals and Organics. Elutriate tests do not indicate that significant releases of any of the trace metals would occur in the dredged effluents. These constituents and other toxicants, including synthetic hydrocarbons, should remain attached or chemically bonded to fine suspended particles rather than in the dissolved phase. Analyses for pesticides and other synthetic hydrocarbons were well above EPA criteria. Although ammonia would be present, the prevailing physical and chemical conditions (pH and temperature) at the discharge sites would not be favorable to the production of un-ionized ammonia gas, which is highly toxic to aquatic life. Some potential would remain for the introduction of toxicants to closed distributary channels by leaching and rainfall runoff from the closure materials. The unsubmerged portions of closure dams would be characterized by oxidized conditions, which would affect the pH of the sediments and the solubility of bound metal ions. Given the likelihood of minimal erosive rates after construction and the low levels with respect to EPA criteria of toxic metals in the sediments, the potential for significant contamination of adjacent waters would be remote.

(d) Pathogens. The Atchafalaya River is classified by the State of Louisiana as suitable for primary contact recreation, meaning that a log mean of 200/100 ml fecal coliform colonies is not to be exceeded in a series of at least five samples taken on a 30-day period. Hardly any of the materials to be dredged would have been exposed to human or animal waste material in recent history, and as such should be very low in pathogenic content. No threats to human health as a result of dredging would be anticipated.

(e) Esthetics. The increased turbidities created by dredged materials discharged into the main channel and at distributary closure sites would not be esthetically pleasing. In the main channel, the increases over background turbidities should not be easily discernible except in the immediate vicinity of the discharge locations. Distributary turbidity increases caused by uncontrolled erosion of closure dams during their construction would be more obvious, and probably would persist beyond the construction periods. In the long term, however, the reaches between the closures and the respective realinements would become less turbid than before construction. Although revetments would not be in character with the natural environment, their erosion control effects would be esthetically pleasing.

(3) Effects on Biota.

(a) Primary Production. Primary production in a large turbid, alluvial river such as the Atchafalaya is generally low. Phytoplankton numbers and diversity are low because of turbidity, depth, and velocity. The turbidity engendered by disposal of excavated material into the river, return of diked effluent, and the construction of closure dams and revetments would temporarily reduce primary productivity. Effects in the main channel would be less severe than those downstream of closure dams. Eventually the water column in the portions of the old distributary channels between the dam and the new channel would be less turbid, thus allowing a higher primary productivity than at present. The covering of 200 acres of bottomland hardwoods would have essentially no impact on aquatic primary productivity because these woods are surrounded by old levees and only rarely export detritus to the aquatic system. The area might occasionally be flooded from rainfall and would then have a minor amount of phytoplankton productivity. When the excavated material was placed on it, this primary production would be lost.

(b) Suspension/Filter Feeders. As described earlier, suspension feeders are not abundant in the main channel and those there are adapted to high turbidity. Turbidity caused by channel disposal of excavated material, effluent from the diked disposal area and construction of closure dams and revetments would adversely affect filter feeders downstream during construction. A few organisms would probably be destroyed directly while others would be damaged, but would survive. Recolonization after cessation of dredging would probably be fairly rapid. The small amount of benthic productivity that presently exists in the 200 acres of occasionally flooded forest would be permanently lost.

(c) Sight feeders. Sight feeders common in the channel such as catfish, shad, and buffalo would probably vacate the area during construction.

(4) Actions to Minimize Impacts. The choice of cool-weather months to perform dredging operations would be less stressful on dissolved oxygen supplies. The use of a leveed and diked forest disposal area would prevent adverse suspended particulate-related impacts from the major share of materials dredged for distributary realinements. The establishment of stable dikes of shell or other suitable material before the placement of hydraulic fill to construct the closure dams would effectively curtail the potentials for excessive turbidity and direct losses of fill material to the water

column. The above-mentioned actions would also serve to minimize the destruction of indigenous biota and/or disturbance of their habitats.

d. Contaminant Determinations. Sediment, native water and elutriate analyses of 33, 40, and 12 parameters, respectively, were performed on samples taken from sites along the Atchafalaya River main channel in 1975. Three of the 14 sites are proximate to distributary realinements and closure locations. The sites are identified on Plates 12 and 13 and measured constituent concentrations are listed on Tables G-11-10, G-11-11, and G-11-12. Site 1 (mile 54.3) is between the proposed and existing inlets to Old Atchafalaya River from the Whiskey Bay Pilot Channel; Site 4 is between the proposed and existing East Freshwater Channel inlets, and Site 5 is between the proposed and existing West Access Channel inlets. A fourth site, No. 6, is located about 1.5 miles downstream of the existing East Access Channel inlet. Sediment and water samples were also taken at the existing Old Atchafalaya River inlet, at mile 55, in 1981; chemical analyses of the sediments, water and elutriates are shown on Table G-11-2. Comparisons of the 1975 and 1981 data in the vicinity of the Old Atchafalaya River distributary sites reveal some apparent discrepancies. The copper measured in the sediment sample was 25 mg/kg in 1975 and was only 6.6 mg/kg in 1981, compared to the EPA Region VI proposed criterion of 50 mg/kg. Lead in the 1975 sediment sample was <10 mg/kg, while in 1981 the concentration was 86.3 mg/kg, compared to the Region VI proposed criterion of 50. The 1975 arsenic concentration in the sediment sample was 16 mg/kg, and in 1981 the measurement was 3.32 mg/kg against the Region VI proposed criterion of 5.0. The 1975 detection limit for cadmium in sediment was 10 mg/kg, so its measurement cannot be compared. The 1975 and 1981 elutriate analyses for eight heavy metals showed each to be below the respective EPA freshwater aquatic life chronic criteria by a factor of two or more. Elutriates made from samples taken at sites 4 and 6 in 1975 showed copper levels of 6 and 13 ug/l, respectively (above the EPA criteria of 5.6 ug/l). Corresponding native water (dissolved) copper levels were 3 ug/l at each site. Arsenic was measured at 11, 8, and 9 mg/kg in sediment samples from sites 4, 5, and 6 in 1975, while cadmium was undetectable below 10 mg/kg, thus precluding comparisons.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton. Plankton populations are rather sparse in main channels and distributaries and would consist mainly of diatoms, desmids, rotifers, and light-bodied copepods and cladocerans. As discussed earlier in Section 11c.(3)(a), primary productivity would be slightly reduced during and shortly after construction in the main channel and distributaries. Post-project primary productivity in the backwater channels should be higher than for existing conditions. Some zooplankton would be destroyed by the excessively high turbidity during construction, but this effort would be temporary and pre-project plankton levels should be attained soon after cessation of construction.

TABLE G-11-10

BOTTOM SEDIMENT DATA, 1975 SAMPLING, SITES 1, 4, 5, AND 6

Parameter	Site Number			
	1	4	5	6
Nitrogen, TOT KJD as N (mg/kg)	440	440	2500	3000
COD, (mg/kg)	14,000	38,000	17,000	17,000
Cyanide, (ug/g)	0	0	0	0
Residue Lost on Ignition, (mg/kg)	44,200	55,400	28,500	37,400
Oil and Grease, (mg/kg)	0	0	0	0
Arsenic, (ug/g)	16	11	8	9
Cadmium, (ug/g)	<10	<10	<10	<10
Chromium, (ug/g)	<10	<10	<10	<10
Copper, (ug/g)	25	25	<10	10
Lead, (ug/g)	<10	<10	<10	<10
Mercury, (ug/g)	0.09	0.06	0.07	0.06
Nickel, (ug/g)	10	20	<10	<10
Zinc, (ug/g)	30	50	30	50
Aldrin, Total (ug/kg)	0.0	0.0	0.0	0.0
Chlordane, Total (ug/kg)	0	0	0	0
DDD, Total (ug/kg)	0.0	0.0	0.0	0.0
DDE, Total (ug/kg)	0.0	0.0	0.0	0.0
DDT, Total (ug/kg)	0.0	0.0	0.0	0.0
Diazinon, Total (ug/kg)	0.0	0.0	0.0	0.0
Dieldrin, Total (ug/kg)	0.0	0.0	0.0	0.0
Endrin, Total (ug/kg)	0.0	0.0	0.0	0.0
Eth. Parth, Total (ug/kg)	0.0	0.0	0.0	0.0
Ethion, Total (ug/kg)	0.0	0.0	0.0	0.0
Hept. Epox, Total (ug/kg)	0.0	0.0	0.0	0.0
Heptachlor, Total (ug/kg)	0.0	0.0	0.0	0.0
Lindane, Total (ug/kg)	0.0	0.0	0.0	0.0
Malathion, Total (ug/kg)	0.0	0.0	0.0	0.0
Met. Parth, Total (ug/kg)	0.0	0.0	0.0	0.0
Met. Trith, Total (ug/kg)	0.0	0.0	0.0	0.0
PCB, Total (ug/kg)	0	0	0	0
PCN, Total (ug/kg	0	0	0	0
Toxaphene, Total (ug/kg)	0	0	0	0

TABLE G-11-11

NATIVE WATER DATA, 1975 SAMPLING, SITES 1, 4, 5, AND 6

Parameter	Site Number 1	4	5	6	EPA Aquatic Life Criteria (ug/l)
Nitrogen, Diss. KJD (mg/l)	0.37	0.65	0.45	0.40	
Residue, Suspen. 110C (mg/l)	30	54	26	32	
Residue, Tot. Nonfil, 105C (mg/l)	27	56	36	22	
Residue, Volat, Susp. (mg/l)	2	4	6	0	
Chemical Oxygen Demand (mg/l) (Filter Sample)	11	11	10	8	
Cyanide (mg/l)	0.00	0.00	0.00	0.00	0.0035
Phenols (ug/l)	6	10	6	4	2600
Oil and Grease (mg/l)	2	14	0.0	0.0	
Arsenic, Dissolved (ug/l)	1	1	1	2	40
Cadmium, Dissolved (ug/l)	0	0	0	0	0.025*
Chromium, Dissolved (ug/l)	0	0	0	0	0.29
Copper, Dissolved (ug/l)	5	3	3	3	5.6
Lead, Dissolved (ug/l)	0	0	0	0	3.8*
Mercury, Dissolved (ug/l)	0.1	0.1	0.0	0.0	0.20
Nickel, Dissolved (ug/l)	3	2	3	4	96*
Zinc, Dissolved (ug/l)	10	10	10	10	47
Aldrin, Total (ug/l)	0.00	0.00	0.00	0.00	0.0019**
Chlordane, Total (ug/l)	0.0	0.0	0.0	0.0	0.0043
DDD, Total (ug/l)	0.00	0.00	0.00	0.00	
DDE, Total (ug/l)	0.00	0.00	0.00	0.00	
DDT, Total (ug/l)	0.00	0.00	0.00	0.00	0.0010
Diazinon, Total (ug/l)	0.00	0.12	0.01	0.05	
Dieldrin, Total (ug/l)	0.00	0.00	0.00	0.00	0.0019**
Endrin, Total (ug/l)	0.01	0.01	0.01	0.00	0.0023
Eth. Parth., Total (ug/l)	0.00	0.00	0.00	0.00	
Eth. Trith, Total (ug/l)	0.00	0.00	0.00	0.00	
Ethion, Total (ug/l)	0.00	0.00	0.00	0.00	
Hept. Epox., Total (ug/l)	0.00	0.00	0.00	0.00	
Heptachlor, Total (ug/l)	0.00	0.00	0.00	0.00	0.0038
Lindane, Total (ug/l)	0.00	0.00	0.00	0.00	0.01
Malathion, Total (ug/l)	0.00	0.00	0.00	0.00	0.1
Met. Parth., Total (ug/l)	0.00	0.00	0.00	0.00	
Met. Trith., Total (ug/l)	0.00	0.00	0.00	0.00	
PCB, Total (ug/l)	0.0	0.0	0.0	0.0	0.14
PCN, Total (ug/l)	0.0	0.0	0.0	0.0	
Toxaphene, Total (ug/l)	0	0	0	0	0.013
Silvex, Total (ug/l)	0.00	0.00	0.00	0.00	
2,4-D, Total (ug/l)	0.03	0.20	0.04	0.00	370
2,4-DP, Total (ug/l)	0.00	0.00	0.00	0.00	
2,4,5-T, Total (ug/l)	0.02	0.02	0.03	0.00	

* Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.
** Criteria apply to either parameter or sum of both.

TABLE G-11-12

STANDARD ELUTRIATE DATA, 1975 SAMPLING, SITES 1,4,5, AND 6

Parameter	Site Number 1	4	5	6	EPA Aquatic Life Criteria (ug/l)
Nitrogen, Diss. KJD (mg/l)	0.96	3.1	2.9	2.3	
Chemical Oxygen Demand (mg/l) (Filter Sample)	10	23	28	29	
Cyanide (mg/l)	0.00	0.00	0.00	0.00	0.035
Phenols (ug/l)	0	20	17	6	2600
Arsenic, Dissolved (ug/l)	0	2	2	4	40
Cadmium, Dissolved (ug/l)	0	0	0	0	0.025*
Chromium, Dissolved (ug/l)	0	0	1	0	0.29
Copper, Dissolved (ug/l)	3	6	2	13	5.6
Lead, Dissolved (ug/l)	0	0	0	2	3.8*
Mercury, Dissolved (ug/l)	0.1	0.1	0.1	0.1	0.20
Nickel, Dissolved (ug/l)	6	5	0	4	96*
Zinc, Dissolved (ug/l)	10	10	0	10	47

* Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.

(2) Effects on Benthos. Some effects were discussed previously in Section 11a.(4) and 11c.(3)(b). There should be no effects due to the low level of contaminants that might possibly be released by dredging. The quieter, less oxygenated waters between the closure dams and new channels would support a different benthos than exists today and some oxygen problems may develop during low water perids.

(3) Effects on Nekton. As discussed previously in Section 11c.(3)(c), nekton should not be significantly adversely affected by disposal for this feature. If any nekton exists in the temporarily flooded hardwoods, its loss would be insignificant.

(4) Effects on Aquatic Food Web. Disposal in the 200 acres of bottomland hardwoods would have little effect on the aquatic food web because this area makes little contribution at present. Disposal in the main channel, effluent from the diked disposal area, and construction of the closure dams and revetments would have a minor, temporary adverse impact on the aquatic food web by slightly reducing primary and benthic productivity. Primary productivity would increase in the "backwater" portions of the former distributary and benthic productivity might increase if dissolved oxygen problems do not arise.

(5) Effects on Special Aquatic Sites. The only such site that would be directly affected is wetlands. As noted earlier, for purposes of this evaluation, all wooded areas in the basin are considered to be wetlands. The 140 acres of late successional bottomland hardwoods to be utilized as disposal area would revegetate as early successional bottomland hardwoods. The 60 acres to be covered with levees and dikes would remain open land for the life of the project. The wetland values of these areas are minimal at present because the 140 acres are isolated by old levees. The reduction in sedimentation that this feature would engender should help preserve wetland values over large areas of cypress-tupelo swamp and bottomland hardwoods.

(6) Effects on Wildlife. Any wildlife inhabiting the 200 acres of bottomland hardwoods would be affected adversely. Young, slow or weak organisms would be destroyed. Other animals would be forced to relocate on adjacent habitat and might be subjected to inter- or intraspecific population pressures and die or become weakened. These late successional woods are some of the most valuable wildlife habitat in the basin and the early successional species that would replace them would be of less value to wildlife. However, they would be heavily used by certain species--deer during low-water periods and various songbirds during migration. There should be no discernable effect on wildlife due to disposal in the main channel or construction of closure dams.

(7) Effects on Endangered Species. There would be no significant effects. See Appendix H and Section 6, paragraph 6.287 of the EIS for a more detailed discussion.

(8) Actions to Minimize Impacts. See discussion in Sections IIa.(6), IIb.(5), and IIc.(4) above.

f. Proposed Disposal Site Determinations.

(1) Mixing Zone Determinations. The only toxic contaminant shown to be more concentrated in the elutriate phase than its EPA freshwater aquatic life chronic toxicity criterion is copper. For the lowermost distributary realinement (East Access Channel) a dilution factor of about 1.5 would probably be sufficient to reduce dredged slurry copper levels to less than the EPA criterion in the water column, if the elutriate test is a reliable indicator of the discharged material characteristics. This would be readily achievable in the case of main channel disposal, thus a mixing zone determination would be unnecessary. Although rates of introduction of suspended sediments into the water column at the closure sites are considerably more difficult to predict, nothing in the chemical analyses or the anticipated background conditions suggest that toxic contaminants would be capable of significantly affecting a substantial portion of the water column downstream of any of the closure sites.

(2) Determination of Compliance with Applicable Water Quality Standards. Currently applicable EPA numerical criteria for heavy metals and other parameters in water are shown in Table G-11-13. Current State of Louisiana numerical criteria for applicable waters (Atchafalaya River and Headwaters to mile 118) are shown in Table G-11-6. Qualitative state criteria are shown in Table G-11-6A. The referenced site-specific chemical analyses were compared to the criteria and standards, and notations were made for each measured or suspected violation. As noted above, the high dilution potentials of the receiving water bodies and their favorable background levels of pH, dissolved oxygen and temperature should readily reduce contaminant concentrations below harmful levels in each instance. The presence of elevated turbidity levels immediately adjacent to the dredging and discharge sites would be unavoidable consequences of the activities, but would not represent highly unusual conditions for those water bodies.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supply. No direct or indirect effects on water supplies are expected, since water supplies are not taken from surface waters that would be affected by the proposed discharges.

(b) Effects on Recreational and Commercial Fisheries. No significant impacts to fishery resources would be anticipated.

(c) Effects on Water-Related Recreation. No impact on recreational potentials of the water bodies or their environs would occur. Recreationists coming up the main channel from the south or those crossing the basin would have slightly longer distances to travel once the distributaries are realined.

(d) Esthetics. No esthetic impacts other than those associated with turbidity plumes and noise during construction activities would be anticipated.

(e) Effects on Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. There are no such areas that would be affected by the proposed discharges. There might be unknown archeological sites within the area. Specifications covering the work to be performed in constructing and maintaining this feature would provide for preservation of any items of apparent historical or archeological interest.

(f) Determination of Cumulative Effects on the Aquatic Ecosystem. The distributary realinements are part of an overall comprehensive plan for the Atchafalaya Basin Floodway System. The plan would accomplish flood control objectives, which are of great importance in the Lower Mississippi Valley, and provide for preservation and enhancement of the very significant fish, wildlife, and other natural resources of the basin. Overall then, the plan would result in preservation and enhancement of significant portions of the basin's aquatic environment, especially through environmental easements. The plan cannot, however, prevent large-scale changes in habitat, from aquatic to terrestrial, as the maturation of the Atchafalaya River continues. The total direct construction impacts of this entire project would result in the loss or modification of approximately 6,000 acres of cypress-tupelo, 9,000 acres of mid-to-late successional bottomland, and 6,000 acres of early successional bottomland hardwoods. This compares to approximately 451,000, 332,000, and 100,000 acres, respectively, of these habitat types within the project-affected area (Table 6-7, page EIS-110, Volume 1). On a percentage basis, construction of the entire project would cause a respective loss of 1.3, 2.7, and 6.0 percent, of these habitat types.

The 200-acre terrestrial habitat alteration caused by the feature considered in this 404(b)(1) Evaluation would be an even smaller percentage of the total loss. The delta area at the river mouth would aggrade slightly more rapidly than at present with fine sand kept out of the swamp areas. Thus, disposal of dredged or fill material as part of the overall plan for the Atchafalaya Basin Floodway System would add to the cumulative loss of habitat in Louisiana, but this amount of loss and/or conversion of habitats is acceptable in the overall public interest.

(g) Determination of Secondary Effects. This project feature should result in lower sediment transport into backswamp areas than would otherwise have occurred. Thus, ecologic impacts of circulation reductions due to excessive siltation would be reduced, if not prevented. The major adverse secondary effects of this feature relate to dredging of the new channels. Approximately 245 acres of late successional bottomland hardwoods, 5 acres of early successional and 10 acres of cypress-tupelo swamp and 22 acres of open water would be converted to channel. Wildlife values on these 260 acres of woodlands would be totally destroyed. Most of these forests are overflowed by the average annual flood and thus would contribute detritus to the aquatic ecosystem as well as provide highly valuable spawning, nursery, and feeding areas for plankton, benthos, and nekton. The newly created distributary habitat would not be as valuable in any of these respects. The present open water habitat to be affected by this feature consists of three "lakes," two of which are remnants of old distributaries. The Blue Hole is presently a deep, clear lake during most of the time, since it rarely receives riverine overflow. Hippy Hole Lake, also deep and clear much of the time, and Sawyer's Cove, a shallow lake, are usually flooded by the average annual flood and thus occasionally receive turbid river waters. All three are presently fairly good fishing areas and their value in this respect would be lost if they were made part of the new distributary channels. Existing benthos in these lakes would be destroyed by dredging and the new benthic populations would be smaller and less diverse. The reduction of sedimentation in backswamp areas would mean that a greater amount of sediment would be available for delta building on Atchafalaya Bay.

III. FINDINGS OF COMPLIANCE FOR DISTRIBUTARY REALINEMENTS.

a. No significant adaptations of the guidelines were made relative to this evaluation.

b. The discharge of dredged material from the Old River realinement into the Whiskey Bay Pilot Channel would be environmentally acceptable, but less so than land disposal in the designated confined location, which would not directly affect any water body. No similar land locations exist that are conveniently located to the other realinement sites, and that would not require controlled effluent releases. The potential impacts of open-water disposal in the main channel would be less than those resulting from such releases into smaller bodies, including distributary channels. The alternative East Access Channel realinement route that would utilize Jakes Bayou and connecting channels would require more dredging and produce greater disposal impacts upon woodlands. This route would also be longer and more difficult for navigation than the proposed route. Sediment traps in the realined channels were rejected also, as presenting greater maintenance problems with respect to dredged material disposal. Their effectiveness in improving floodway sedimentation beyond that of the proposed activity has not been verified. No practicable alternatives exist for disposal of bank grading materials.

c. Temporary and localized dredge-induced turbidity at the realinement sites may violate the State of Louisiana water quality standard for that parameter. Open-water disposal into the main channel would not significantly increase turbidity above ambient levels. Heightened turbidity downstream of the closure construction sites would not occur if the sites were effectively isolated from flowing water by temporary dikes or cofferdams.

d. Reviews of available water quality data collected during both dredging and nondredging periods have shown that dissolved metal concentrations in the Atchafalaya River and other waterways are generally affected only temporarily and locally by hydraulic dredging processes. Prevailing physiochemical conditions do not favor the release of un-ionized ammonia even where sediments have high nutrient levels. Investigations have not revealed any significant concentrations of biologically available pesticides or other synthetic compounds in native water, dredge discharges or elutriate mixtures. Minimum detection limits were well above EPA criteria for several substances, however, so that definite conclusions could not be drawn.

e. The proposed discharges would not impact any endangered species nor their critical habitat.

f. No designated marine sanctuaries are in the project-affected area.

g. The discharges would have no measurable adverse effects on human health and welfare with respect to: municipal or private water supplies; recreational or commercial fisheries; plankton; fish; shellfish; wildlife; or special aquatic sites. Life stages of aquatic life or aquatic ecosystem-dependent wildlife species would not be adversely affected. There would likewise be no significant adverse effects on aquatic ecosystem diversity and productivity that would not be compensated by project-induced ecosystem enhancements. All affected ecosystems would restabilize reasonably soon after construction. Nothing more than temporary adverse effects on recreational esthetic or economic values would result from the dredged material discharges. The construction of this feature should reduce sedimentation in the Atchafalaya Basin Floodway and thus preserve environmental values and improve flood control.

h. Appropriate and practicable steps that have been identified to minimize potential adverse impacts on the aquatic ecosystem include: dike construction along the Old Atchafalaya River realinement; performance at work during moderate flow periods; dikes or cofferdams to separate closure dam construction from direct contact with flowing water; and dredging and disposal during cool-weather months.

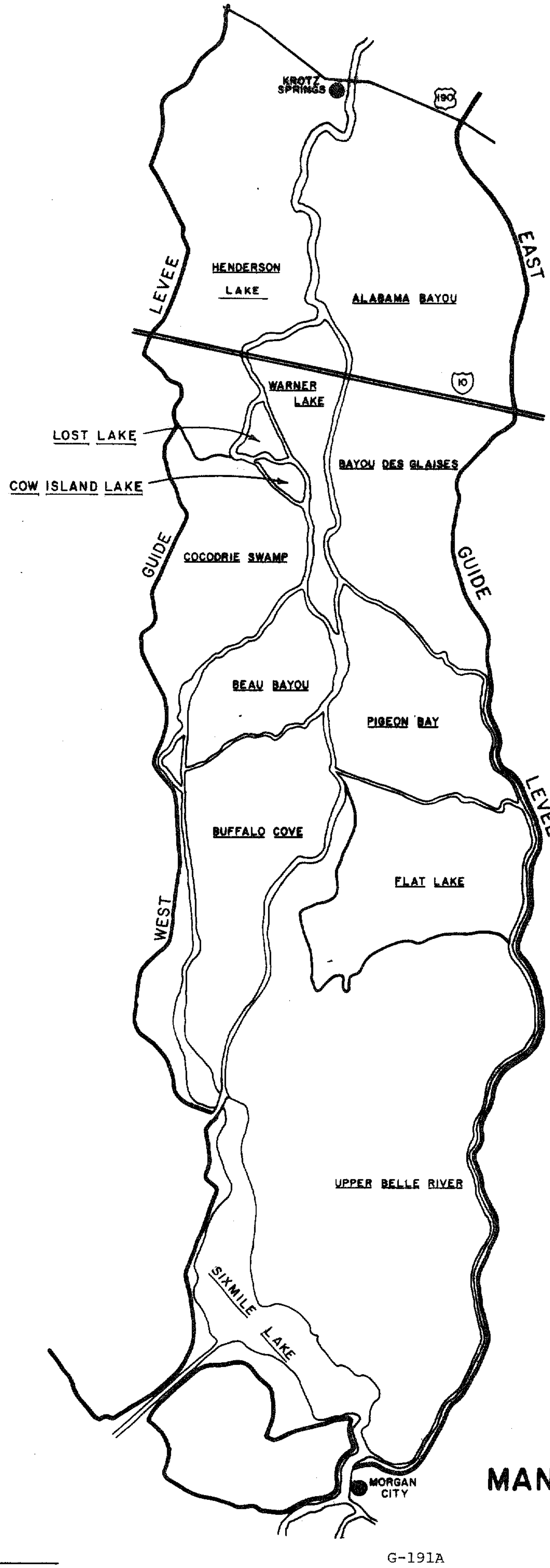
i. On the basis of the guidelines, the proposed disposal sites for the discharge of dredged material are specified as complying with their requirements with the inclusion of the appropriate and practical conditions to minimize pollution and other adverse effects to the affected aquatic ecosystem.

Management Units/Freshwater Structures

I. PROJECT DESCRIPTION.

a. Location. The Atchafalaya Basin is a large, shallow depression lying within the deltaic plain of the Mississippi River in south Louisiana. The boundaries of the study area are the natural levee ridges of the Mississippi River and the abandoned Lafourche distributary on the east, and the natural levee ridges of the old Teche and Cypremort courses of the Mississippi on the west. Natural processes and human actions have combined to produce distinct environmental and hydrological subdivisions within the Lower Atchafalaya Basin Floodway. The hydrologically distinct areas have been identified as management units for purposes of this study. Figure G-11-1 illustrates the thirteen management units identified. This evaluation addresses the two units selected for pilot studies and two freshwater diversion structures associated with hydrologic management in this project.

b. General Description. Thirteen management units were studied to determine their feasibility for restoring historical overflow conditions to benefit the aquatic ecosystem. The Buffalo Cove and Henderson units are proposed as pilot units for initial implementation according to plans developed in conjunction with representatives of US FWS, EPA and appropritae state agencies. The Buffalo Cove area is bordered on the east by the main channel and on the west by Lake Fausse Pointe Cut. Because of the large flow conveyed through the west access channel and Lake Fausse Pointe Cut (15 percent of basin flow), Buffalo Cove is subject to levee-building on both sides. Through the natural levee-building process which has already taken place, and the sediment disposal near the main channel, the eastern side of Buffalo Cove is already becoming a confining levee of the main channel. Along its western edge, particularly in the southwestern portion, water and sediment overflows into Buffalo Cove on a regular basis. In addition, access channels, such as the Si Bon Canal, convey a significant amount of water and sediment into the center of the area. These conditions would subject the entire area of Buffalo Cove to about 5 feet of additional sediment deposition over the next 50 years. Development of management units would require the restriction of their natural outlets by construction of weirs and, in some cases, low-level levees (see Plate G-14). Levees would only be built to raise the perimeter of the unit (where necessary). Construction of new inlets at the upper end of the management unit would also be necessary, as well as the closure of certain bayous and canals, and the improvement of circulation within the unit. Rollovers to provide for small boat access would be installed at bayou and canal closures. The Buffalo Cove unit would be divided into upper and lower areas. The larger upper area would have its inlet at Wanda Canal, and outlets at the south end of Buffalo Cove Lake and in Grand Lake. The



MANAGEMENT UNITS

FIGURE G 11-1

smaller lower area would not have a controlled inlet, but waters would enter through Little Lake Long. The outlet would be just north of Myette Point. Approximately 6 miles of levees would be required for each area. No levees should be required for the Henderson unit. Maintenance would consist of trash and debris removal from inlets and outlets, any necessary levee repairs, and boat rollover maintenance. Also included in the evaluation is the construction of the "Courtableau," and Sherburne freshwater diversion structures to provide freshwater inflow to the Henderson Lake and Alabama Bayou areas, respectively. The "Courtableau" freshwater diversion structure would probably be located at Big Bayou Graw and serve as an inlet for the Henderson management unit area. It would consist of two 10-foot box culverts with invert elevations of 10 feet NGVD designed to pass 3,000 cfs and be located in the west Atchafalaya River levee at approximate mile 44.5. The Sherburne freshwater diversion structure, which would also include two 10-foot box culverts with invert elevations of 10 feet NGVD designed to pass 3,000 cfs, would be located in the east Atchafalaya River levee at mile 43. Maintenance of both structures would consist of periodic inspection, removal of accumulated debris, and any repairs needed.

c. Authority and Purpose. The freshwater diversion structures are authorized by the Flood Control Act of 15 May 1928, Public Law 291-70, as amended. Study of the management units was authorized by resolutions by both the US Senate and House Committees on Public Works, 23 March 1972 and 14 June 1972, respectively, to develop a comprehensive plan for the preservation and management of the water and land resources of the Atchafalaya Basin. By letter dated 18 June 1976, the Director of Civil Works of the Office of the Chief of Engineers directed the President of the Mississippi River Commission to address both the previously authorized features of the Atchafalaya Basin Floodway project and potential features for resource preservation and management, effectively combining studies of the Atchafalaya Basin Floodway project with those previously mandated by Congress. The accompanying report and EIS seek Congressional authorization to construct the two pilot management units. The purpose of the management units and diversion structures is to attempt to restore historical overflow patterns as much as possible, and to encourage water movement through the units. This feature might also restrict sediment movement and deposition while increasing the amount of nutrient and organic matter supplied to the estuarine area and the Gulf of Mexico.

d. General Description of Dredged and Fill Material. The main dredged and fill material considerations for the Buffalo Cove management unit are: excavation for the Alligator Bayou inlet structure and channel; excavation for two outlet structures and channels along Grand Lake and one at the lower end of Buffalo Cove Lake; levee building to supplement low natural ridges (below average annual flood level) in the lower reaches along Grand Lake; the cutting of gaps through dredged material banks of canals impacting water circulation (Florida

Gas Canal, Wanda Canal, and Si Bon Canal); channel closures at various locations; and excavation for a small boat access canal. The Henderson management unit's structural features would be primarily limited to inlet channel excavation for conveyance of main channel flows through and downstream of the Courtableau freshwater diversion structure. Some gaps might be cut through channel banks to increase circulation within the unit. Detailed plans for the other management units would be prepared in the future. Construction of diversion structures would also involve excavation of inlet channels and placement of fill material.

(1) General Characteristics of Material. The material is generally deltaic deposits overlaying backswamp clays. A soil sample taken at the proposed Wanda Canal inlet site consisted of 65 percent sand, 27 percent silt, and 8 percent clay. Other samples were obtained at the Henderson unit outlet location on the WABPL Burrow Pit, and at an alternate site for the Courtableau unit (West Atchafalaya River levee at mile 48). The sand-silt-clay ratios were 6-37-57 and 58-38-4, respectively.

(2) Quantities of Material. Quantities are tentative for the Buffalo Cove unit, but are presently estimated at about 700,000 cubic yards for all dredging works. The total quantity of material estimated to be dredged in the Henderson unit is unknown but would probably be less than that dredged for the Buffalo Cove unit. Quantities associated with construction of the two diversion structures are unknown.

(3) Sources of Material and Disposal Methods. Material would be excavated by dragline directly from the Courtableau and Sherburne inlets, Alligator Bayou, Lake Fausse Point Cut, distributary channel and canal banks, and from the sites of the outlet structures and channels along Grand Lake (natural levees). Disposal would be by casting onto nearby land areas. The levees would be cast from the adjacent channel. Closures would be made using material from the nearest suitable dry land borrow sources.

e. Description of Proposed Discharge Sites.

(1) Locations. Locations of the proposed discharge sites for the Buffalo Cove unit are shown on Plate G-14. Discharge of dredged or fill material would occur at most features indicated on the plate. Locations of the proposed Courtableau and Sherburne freshwater diversion sites are shown on Plates 15 and 16, respectively. Other possible disposal sites for the Henderson unit are unknown at this time.

(2) Types of Sites. Construction of most features for the management units would be unconfined disposal on adjacent land. Canal closures would require open water disposal. Excavated material from

the Courtableau and Sherburne diversion structure sites would be disposed on diked land areas near the sites.

(3) Sizes of Sites and Types of Habitat. This information is indicated in Table G-11-13.

TABLE G-11-13

SIZES OF DISPOSAL SITES AND TYPES OF HABITAT FOR MANAGEMENT UNITS AND FRESHWATER STRUCTURES

Site Location	Number of Acres[1/]	Habitat Type
Sherburne Freshwater Diversion Structure Inlet	25	BLHW[2/]
"Courtableau" Freshwater Diversion Structure Inlet	2	BLHW
Wanda Canal Inlet	<5	ES[3/], R[4/]
Bayou Eugene Closure and Boat Rollover	1	ES, B[5/]
Gap Cutting in Florida Gas and Wanda Canals	<10	ES, CT[6/], B
Si Bon Canal Closure and Boat Rollover	1	ES, R
Gap Cutting in Si Bon Canal	<10	ES, CT, B
Bayou Gravenburg Boat Rollover	1	ES, B
Buffalo Cove Outlet Structure	<5	ES, R
Little Lake Long Boat Launch and Access Canal	2	ES, B
Grand Lake Outlet Structure	5	ES, R
Taylor Point Closure	1	ES, R
Myette Point Outlet Structure	10	ES, R
Levee for Upper Buffalo Cove Unit	100	ES, R
Levee for Lower Buffalo Cove Unit	100	ES, R

[1/]Acreage is conservative estimate, actual plans for many features have not been finalized.

[2/]BLHW = mid-to-late successional bottomland hardwoods.

[3/]ES = early successional bottomland hardwoods.

[4/]R = river and distributary.

[5/]B = bayou and canal.

[6/]CT = cypress-tupelo

f. Description of Disposal Method. Disposal would be by dragline.

II. FACTUAL DETERMINATIONS.

a. Physical Substrate Determinations.

(1) Effects on Substrate Elevation and Slope. Levees would be IV on 3H slopes with elevations designed to allow bi-annual overbank flooding. Closures would also allow bi-annual overbank flooding.

(2) Effects on Sediment Type. Levee embankment and closure material would be obtained from adjacent areas and so would be of similar type. Some riprap and other stone would be imported to the area for use in constructing the diversion structures, and inlets and outlets to the Buffalo Cove management unit. Material from gap cutting would be old disposal and therefore similar to the area in which it would be placed.

(3) Effects on Dredged/Fill Material Movement. Slight movement and leaching would occur during normal storm events. No noticeable impact would be expected.

(4) Physical Effects on Benthos. Land-based disposal from the freshwater structures would reduce benthic use of the late successional bottomland hardwoods. Construction of inlet and outlet structures and closures for Buffalo Cove would destroy any benthos in the immediate area. Disposal of material from gap cutting and construction of the Little Long access canal would destroy existing benthos in the disposal areas and reduce future benthic usage. The covering of 200 acres of seasonally-flooded early successional bottomland hardwoods by levee building would destroy the existing benthos and reduce the future use of these acres by benthic organisms.

b. Water Circulation, Fluctuation, and Salinity Determinations.

(1) Effects on Water.

(a) Salinity. No effects would occur.

(b) Water Chemistry. No substantive effects would occur.

(c) Clarity. During excavation, construction, and dredging operations, water clarity in adjacent wetlands or water bodies would be significantly reduced. This condition would be temporary and would rapidly return to normal following project operations.

(d) Color. Water color would be affected similarly to water clarity.

(e) Odor and Taste. No effects would occur.

(f) Dissolved Gas Levels. The dissolved gas of major concern is oxygen. Oxygen levels are generally dependent on flow conditions and temperature in the wetland areas of the Atchafalaya region. Low levels occur in the warm summer months. The circulation increase achieved by the management units and diversion structures would serve to improve oxygen conditions. A full discussion on oxygen effects appears in Section II.c.(2)(b).

(g) Eutrophication. Small increases in the nutrients would not be expected to induce significant eutrophication.

(h) Nutrients. Nutrients in Atchafalaya wetland areas are at generally low levels. Primary production is dependent to a large degree on the recycling of nutrients by bacterial action. Nutrient levels generally decrease as a function of distance away from the major waterways. By improving the circulation with management units and diversion structures, nutrients would be increased in the Henderson and Buffalo Cove areas. The Sherburne diversion structure would positively affect nutrient levels in the Alabama Bayou area.

(2) Effects on Current Patterns and Circulation.

(a) Current Patterns. Construction of the Sherburne structure would alter existing current patterns, allowing more water to flow in Alabama Bayou, Little Alabama Bayou, and Bayou des Glaises. Construction of the Courtableau structure would increase the flow-through in the Henderson unit with more water in Big Bayou Graw, Bayou Fordoche and other waterbodies in the southern portion of the unit. Work in the Buffalo Cove area would reconnect the Wanda Canal to the West Access Channel to bring water in at the north end of the unit. Closure of the Si Bon Canal at Lake Fausse Pointe Cut should reverse flow in the canal and allow it to flow south and west. Bayous Gravenburg and Eugene would have more flow than at present. The outlets at Buffalo Cove Lake and in Grand Lake in conjunction with the levee would prevent rapid drainage of the Buffalo Cove-Mud Lakes area. Flow through Buffalo Cove Lake would be in a southerly direction most of the year. Construction of the levee for the lower Buffalo Cove unit, the Taylor Pointe closure, and the Myette Point outlet would prevent flow from the channel through Grand Lake from entering the southern portion of Grand Lake. Construction of these two units could help prevent some bayous and lakes from draining during low water.

(b) Velocity. Higher velocities would be expected in the upper and middle portions of the Buffalo Cove unit, all portions of the Henderson unit and all areas affected by the Sherburne structure. Constriction of outlet flows might decrease velocities in the southern portion of the Buffalo Cove unit. This decrease in velocity might cause channel configuration to be shallower and more uniform.

(c) Stratification. There would be no stratification effects.

(d) Hydrologic Regime. The whole purpose of management unit and diversion structure construction is to restore the hydrologic regime to mimic as closely as possible historical natural water overflow patterns. Construction of management units could reduce by as much as half the amounts of water flowing through the units each year; however, they would allow more water retention than would occur under without-project conditions.

(3) Normal Water Level Fluctuations. The purpose of management units would be to maintain water levels in the unit as they were in 1965. Desired hydrographs were prepared for each unit; these attempted to reproduce the 1965 water year (see Section 6 of this appendix for methodology). In the short-term, management units would slightly increase the peaks of flooding for the first decade of project life. Studies indicate that neither the Henderson nor Buffalo Cove units could preserve present water levels, which are lower than the 1965 levels. However, compared to future without-project conditions, management units would, on the average, experience given flooding levels an average of 3 to 4 weeks longer from mid-March to mid-May and 2 months longer from January through July. Management units would reduce the degree of short-term water level fluctuations within each unit (see Figure 6-1 in the EIS). The amounts of water entering lower management units would be reduced and therefore current velocities would also be reduced.

(4) Salinity Gradients. Not applicable in this area.

(5) Actions That Will Be Taken to Minimize Impacts. Overall, this project would have positive environmental impacts. Precautions to minimize disruption during implementation of the project would be taken.

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site. Suspended particulates and turbidity would increase substantially in the vicinity of each construction or excavation operation. This condition would be temporary, rapidly returning to normal following completion of the work. Changes in water patterns might affect long-term suspended particulate and turbidity levels, however, adjustment up or down would not be expected to be noticeable.

(2) Effects on Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Most excavation and placement work for the inlets, outlets, closures, and levees of the Buffalo Cove and Henderson management units and the Sherburne structure would be accomplished in water bodies which generally have moderate to swift water movement. Light penetration would be reduced in these waters as a result of the proposed construction activities. Coarse solids lost to water bodies and wetlands should settle from suspension readily. Finely divided and colloidal materials lost to the waters and wetlands may cause longer periods of high turbidity. The screening and filtering action of vegetation in some of the wetland areas might help to limit the water column effects of increased suspended solids and turbidity levels.

(b) Dissolved Oxygen. Dissolved-oxygen concentrations are of primary importance in the Atchafalaya River Basin. Fish and other aquatic life require adequate levels of dissolved oxygen for egg and larval development and normal growth and activity. There is no specific dissolved-oxygen concentration that is favorable to all species and ecosystems. However, low dissolved-oxygen concentrations are unfavorable to almost all aquatic organisms. The principal source of oxygen in the Atchafalaya River Basin is reareation of the water from atmospheric oxygen. The solubility of oxygen in water is inversely related to temperature. As the temperature of the water increases, the amount of atmospheric oxygen the water is capable of holding decreases. Oxygen also is produced in some areas of the basin as a byproduct of photosynthesis. Dissolved-oxygen concentrations in off-channel portions of the management units and the Alabama Bayou area are generally dependent upon temperature and flow conditions. During periods of high flow a sufficient supply of freshwater reaches these areas and dissolved-oxygen concentrations are maintained at a high level. During the low-flow summer months smaller quantities of water reach these areas. Dissolved-oxygen concentrations decline to low levels in some swamp areas during the spring because of the increased effect of organic degradation and the lack of a sufficient supply of oxygen from the river or from photosynthetic production. Backswamp areas which are presently subject to low dissolved oxygen conditions in the spring high water season could experience worsened oxygen problems within the management units, especially if inflowing waters do not circulate to all parts of the unit. This could occur, for example, by short-circuiting or impedence of water circulation caused by the creation of dredged material embankments during canal dredging by the oil and gas industry. Implementation of management units and diversion structures would lower dissolved oxygen levels during the construction phase, but would exert a long-term positive effect by improving circulation.

(c) Toxic Metals and Organics. The Atchafalaya River Basin would not be expected to harbor significant amounts of toxic substances. A sampling program conducted by the New Orleans District Corps of Engineers in 1981 included two samples in the Henderson area and one sample in the Buffalo Cove area. Tables G-11-14 through G-11-16 list the results of chemical analyses of water, sediment and elutriates from the three sites. The elutriate tests (indicatative of the composition of dredged slurry material released from a hydraulic dredge pipeline) did not reveal any significant releases of toxicants, although some parameters were not measurable at EPA criteria levels. For this reason, pesticide analyses (not shown) were generally inconclusive.

(d) Pathogens. No effect as a result of proposed construction or excavation operations.

(e) Esthetics. Temporarily high turbidity levels may detract from esthetic appeal during construction and excavation. The boost in aquatic productivity in these areas should positively affect long-term esthetics.

(3) Effects on Biota. The impacts of managèment units per se are discussed in Section II.e. following.

(a) Primary Production. The turbidity engendered by disposal for these features would slightly reduce primary productivity during the construction periods and for a short-time thereafter. This impact would not be significant in this turbid water ecosystem that is mainly detritus-driven.

(b) Suspension/Filter Feeders. Construction would cause temporary turbidity which would have a slight adverse impact on suspension/filter feeders. Some would be directly destroyed and others would be weakened and eventually die. However, repopulation should occur fairly quickly upon cessation of dredging.

(c) Sight Feeders. The temporary turbidity caused by construction would cause sight feeding fish and crawfish to move to adjacent clearer areas; thus there would be essentially no impact.

(4) Actions Taken to Minimize Impacts. This feature would have positive environmental impacts. Attempts would be made to minimize turbidity during construction.

d. Contaminant Determinations. Due to the lack of significant industrial, municipal, or agricultural pollution sources in the Atchafalaya Basin, native soils are considered unlikely to contain substantial contaminant amounts. Several samples were taken within the two proposed management units. The analyses and implications were discussed earlier in Section II.c.(2)(c). No significant contamination would be expected due to the proposed project actions.

TABLE G-11-14

WATER AND SEDIMENT DATA
SITE NO. 4, 1981 SAMPLING
BAYOU COURTABLEAU

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Total Solids, % by Wgt					65.4
Total Volatile Solids					1.48
Turbidity	4,000				
Suspended Solids	26,300				
Volatile Suspended Solids	8,600				
Oil and Grease					271
Chlorides	30,000				
COD	22,000	16,000	22,000		29,700
TKN	640		1,360		323
Cyanide	< 10		< 10	3.5	
Phenols	< 10		< 10	2,600	
Nitrite-N	< 10		< 10		< 0.20
Nitrate-N	129		122		< 0.20
Total Nitrogen-N	770		1,480		323
Ammonia-N	10		704	20**	15.1
OrthoPhosphate-P	11	< 10	< 10		0.86
Total Phosphorus-P	< 100	< 100	< 100		345
Calcium	59,000	59,500	56,600		
Magnesium	16,200	16,600	14,600		
Manganese	191	2	1,300		296
Iron	266	30	< 25	1,000	6,230
Mercury	< 0.2	< 0.2	< 0.2	0.20	< 0.10
Lead	1	2	< 1	3.8*	80.9
Zinc	266	< 25	< 25	47	24.2
Chromium	< 1	1	< 1	0.29	7.35
Cadmium	< 0.1	0.1	< 0.1	0.025*	0.33
Copper	1	1	1	5.6	2.98
Nickel	18	< 1	< 1	96*	9.13
Arsenic	2	2	1	40	3.87

* Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.
**Criterion is for un-ionized ammonia, which would comprise about 1 percent of total ammonia at anticipated pH and temperature conditions.

TABLE G-11-15

WATER AND SEDIMENT DATA
SITE NO. 6B, 1981 SAMPLING
FLOODSIDE BORROW PIT NEAR HENDERSON CONTROL STRUCTURE

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Total Solids, % by Wgt					50.3
Total Volatile Solids					3.31
Turbidity	41,000				
Suspended Solids	44,000				
Volatile Suspended Solids	21,400				
Oil and Grease					192
Chlorides	45,000				
COD	28,000	22,000	19,000		55,800
TKN	950		1,720		871
Cyanide	< 10		< 10	3.5	
Phenols	< 10		< 10	2,600	
Nitrite-N	11		30		< 0.20
Nitrate-N	433		260		< 0.20
Total Nitrogen-N	1,390		2,010		871
Ammonia-N	38		1,000	20**	45.8
OrthoPhosphate-P	62	< 10	< 10		0.860
Total Phosphorus-P	140	< 100	< 100		793
Calcium	22,100	22,500	24,800		
Magnesium	8,050	8,310	8,010		
Manganese	70	6	1,100		935
Iron	2,720	31	62	1,000	25,000
Mercury	< 0.2	< 0.2	< 0.2	0.20	< 0.10
Lead	< 1	1	< 1	3.8*	196
Zinc	< 25	< 25	< 25	47	89.2
Chromium	< 1	< 1	< 1	0.29	24.4
Cadmium	0.6	0.2	< 0.1	0.025*	0.71
Copper	4	2	3	5.6	24.8
Nickel	2	3	< 1	96*	30.6
Arsenic	2	< 1	2	40	7.69

* Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.
**Criterion is for un-ionized ammonia, which would comprise about 1 percent of total ammonia at anticpated pH and temperature conditions.

TABLE G-11-16

WATER AND SEDIMENT DATA
SITE NO. 13, 1981 SAMPLING
WEST ACCESS CHANNEL AT WANDA CANAL

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Total Solids, % by Wgt					73.1
Total Volatile Solids					1.11
Turbidity	34,000				
Suspended Solids	56,500				
Volatile Suspended Solids	14,400				
Oil and Grease					375
Chlorides	30,000				
COD	11,000	7,000	20,000		9,060
TKN	710		980		176
Cyanide	< 10		< 10	3.5	
Phenols	< 10		< 10	2,600	
Nitrite-N	35		45		< 0.20
Nitrate-N	1,520		1,430		< 0.20
Total Nitrogen-N	2,270		2,460		176
Ammonia-N	450		448	20**	6.70
OrthoPhosphate-P	71	270	13		3.11
Total Phosphorus-P	160	< 100	< 100		374
Calcium	40,000	38,100	48,100		
Magnesium	11,700	10,900	13,900		
Manganese	91	18	1,490		335
Iron	2,430	110	< 25	1,000	10,800
Mercury	< 0.2	< 0.2	< 0.2	0.20	< 0.10
Lead	3	1	< 1	3.8*	88.6
Zinc	< 25	< 25	< 25	47	41.6
Chromium	3	< 1	< 1	0.29	13.8
Cadmium	0.6	0.3	< 0.1	0.025*	0.24
Copper	4	4	6	5.6	7.28
Nickel	< 1	< 1	1	96*	15.7
Arsenic	2	1	1	40	3.96

* Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.
**Criterion is for un-ionized ammonia, which would comprise about 1 percent of total ammonia at anticipated pH and temperature conditions.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton. Plankton populations in the swamps and lakes to be beneficially impacted by these features are generally quite rich and diverse. Zooplankton populations in the basin are generally divided into two recurrent groups: those associated with riverine waters and those connected with all other habitat types (bayous, lakes, and swamps). Common genera within management units would include ostracods, heavy bodied cladocerans, and copepods. Phytoplankton populations would be high in lakes during the low-water periods when turbidity is decreased. Typical groups would be diatoms, bluegreens, greens, and flagellates. Temporary turbidity would slightly reduce plankton populations. The overall impact of construction of management units would be to increase primary and detrital productivity by preserving more aquatic habitat than would exist under without-project conditions. The increased amount of aquatic habitat would allow greater numbers of zooplankton to be produced within management units.

(2) Effects on Benthos. Lakes are only moderately productive habitat in terms of numbers, but show great species diversity. The most common organisms are crawfish, snails, midges, and tubificid worms. Swamps, with their rich detrital substrate, are the most productive benthic habitat in the basin. Swamps appear to act as a benthic "reservoir"; the benthic organisms are flushed out of the swamps into other habitats by floodwaters. Clams, fly larvae, and isopods are the most abundant organisms. By preserving more aquatic habitat and increasing flooding over without-project conditions, management units would preserve the numbers and diversity of benthic organisms. The habitats that would be improved by management units are those that are important for benthos, such as: lakes, with the mean number of aquatic organisms per square meter being 1,800; bayous, with 3,300; and swamps, with 3,800.

(3) Effects on Nekton. Lakes are fairly productive fishery habitat, with the most common species being shad, mullet, bowfin, gar, and numerous sunfish (Grand Lake had a sport fish standing crop of 135 pounds per acre in 1977). Swamps are less valuable than lakes as fishery habitat, but they provide spawning and nursery areas. Bottomland hardwoods also provide valuable fishery habitat when flooded. Temporary turbidity would cause only an insignificant impact on fish. The ultimate result of management units would be to increase fishery productivity by several means. Retaining higher water levels in units would prevent delay in production of juvenile crawfish and cannibalism of young in burrows. By keeping forests flooded for additional time, small fish would be able to stay longer in this nursery area and would therefore be larger and more able to escape predators as their habitat became restricted by falling water levels. Management units would preserve aquatic habitat in the summer, and these areas would become available for fish as higher temperatures

made shallower areas uninhabitable. Units would flood more forestland than would be flooded under future without-project conditions. Flooding these forests would increase the amount of detritus available to the system and, thereby, increase fishery productivity.

(4) Effects on the Aquatic Food Web. At present, the flooding and dewatering of the basin plays a vital role in the cycles of distribution of phytoplankton, zooplankton, and benthos throughout the system. The restriction of flow caused by management units may slow these cycles. However, compared to future without-project conditions, construction of management units would preserve the cycles as the basin dries out. This restriction of flow would probably reduce the amount of organic matter exported to the system downstream. Studies have shown a positive correlation between organic matter export and runoff for several watersheds. Thus, management units would probably reduce export compared to the present, but would provide more export than would occur under future without-project conditions. Thus, on balance, management units would be beneficial to the aquatic ecosystem by improving planktonic, detrital, benthic and nektonic productivity, and by increasing the amount and quality of available aquatic habitat. In Buffalo Cove where future water levels might be temporarily higher than exist at present, ground cover might be reduced, and the loss of this potential detritus could slightly decrease fishery productivity.

(5) Effects on Special Aquatic Sites.

(a) Wildlife Management Areas. The Buffalo Cove management unit would include approximately one-third of the Attakapas Wildlife Management Area. Construction would cause temporary turbidity, but the management unit would improve aquatic productivity in the area.

(b) Wetlands. As noted earlier, for purposes of this evaluation, all habitats found in the proposed disposal areas (cypress-tupelo, mid-to-late successional bottomland hardwoods, and early successional bottomland hardwoods) are considered wetlands. The proposed discharge would permanently remove approximately 250 acres of woodlands from production, either by construction of inlet and outlet structures, levees, or an access canal. Approximately 20 acres would be impacted by gap cutting. These areas would revegetate with early successional bottomland hardwoods. Overall, construction of management units and freshwater structures would improve wetland values in the affected areas.

(6) Effects on Wildlife and Forests. Construction of management units would have varied impacts on bottomland hardwood forests. Some reports indicate that increased flooding had caused increased mast production and tree growth. Other studies show that flooding that extended into the growing season resulted in seed

destruction. In the basin, it appears that the existing water regime is changing the species composition of hardwood stands by favoring those low-value species that break dormancy late or are highly water tolerant such as bitter pecan and swamp privit. Corps of Engineers studies indicate that in the Henderson unit approximately 2,000 acres of late successional bottomland hardwoods would be flooded until 15 July if a management unit were implemented. With no management units, far fewer acres would be flooded. The flooding caused by management units as opposed to without-project conditions would reduce potential ground cover and understory production and thus decrease the amount of available wildlife food. The extra flooding that would occur for the first decades of project life with management units would probably benefit timber growth. The Buffalo Cove unit, by attempting to maintain current water levels, would insure that portions of the basin remain cypress-tupelo instead of converting to a mixture of bottomland hardwoods--approximately 2,000 acres could be so preserved. The reduction in short-term water level fluctuations combined with reduced flows could adversely affect timber growth and reproduction in cypress-tupelo areas. A more detailed discussion of impacts to forests is contained in the final EIS, paragraphs 6.17 and 6.27. The low-quality hardwoods that might replace the present moderate- to high-quality hardwoods because of increased flooding in management units could reduce wildlife in the basin. The decreased ground cover and understory would also have an adverse impact on wildlife populations. The filling of the wetlands discussed above would drive the indigenous wildlife away and some might die due to increased competition on adjacent lands. Young or slow-moving animals would be directly destroyed.

(7) Endangered and Threatened Species Effects. This feature would have no adverse impact on endangered or threatened species nor on critical habitat.

(8) Actions to Minimize Impacts. Attempts would be made to minimize impacts on fish and wildlife habitat during construction.

f. Proposed Disposal Site Determinations.

(1) Mixing Zone Determinations. In view of the limited possibility of contamination, mixing zone calculations would not be necessary. Variable discharge, unknown quantities of dredged or fill material required, and indefinite chemical analyses would impair determining the mixing zones anyway. Qualitatively, it would be expected that turbidity levels would be high during the construction phase, but would return to near normal soon afterward.

(2) Determination of Compliance with Applicable Water Quality Standards. Water quality standards are established at the state level. Louisiana standards include a limited number of parameters which in general do not reflect industrial pollution (chloride,

sulfate, dissolved-oxygen, pH, coliform bacteria, temperature, and total dissolved solids). With the possible exception of dissolved-oxygen, none of these standards would be violated. In general, the proposed action would improve existing water quality conditions.

(3) Potential Effects of Human Use Characteristics.

(a) Municipal and Private Water Supply. No effects would be expected.

(b) Effects on Recreational and Commercial Fisheries. Impacts on fisheries were discussed in Section IIe.(3) above. Filling of forested wetlands would remove habitat for sport and commercial fish as well as destroy the detritus these areas furnish to fuel the aquatic ecosystem. However, construction and operation of the management units would mitigate these losses to fisheries.

(c) Effects on Water-Related Recreation. The minor loss of wetlands caused by construction of management units would have little impact on water-based recreation. As discussed in the final EIS in paragraph 6.290, habitat losses would not preclude future recreational use, based on an analysis of existing and proposed boat-launching access. The channel closures and weirs proposed as part of the management units would hinder boat access into the units. Rollovers for small boats would be provided. Attempts to maintain present water levels in the management units would benefit local residents and recreationists that depend upon the aquatic productivity of these resources for their livelihood or enjoyment.

(d) Esthetics. No significant effects.

(e) Effects on Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. Approximately one-third of the Attakapas Wildlife Management Area is located in the Buffalo Cove unit. The unit should improve aquatic productivity in this area. There might be unknown archeological sites within this area. Specifications covering the work to be performed in constructing and maintaining the project features would provide for the preservation of any items of apparent historical or archeological interest.

(f) Determination of Cumulative Effects on the Aquatic Ecosystem. The management units and freshwater diversion structures are part of an overall comprehensive plan for the Atchafalaya Basin Floodway System. The plan would accomplish flood control objectives, which are of great importance in the Lower Mississippi Valley, and provide for preservation and enhancement of the very significant fish, wildlife and other natural resources of the basin. Overall, then, the plan would result in preservation and enhancement of significant portions of the basin's aquatic environment, especially through environmental easements. The plan cannot, however, prevent large-scale changes in the habitat, from aquatic to terrestrial, as the maturation of the Atchafalaya River continues. The total direct construction impacts of this entire project would result in the loss or modification of approximately 6,000 acres of cypress-tupelo, 9,000 acres of mid-to-late successional bottomland hardwoods, and 6,000 acres of early successional bottomland hardwoods. This compares to approximately 451,000, 332,000, and 100,000 acres, respectively, of these habitat types within the project-affected area (Table 6-7, page EIS-110, Volume 1). On a percentage basis, construction of the entire project would cause a respective loss of 1.3, 2.7, and 6.0 percent of these habitat types. The terrestrial habitat loss caused by the two features considered in this 404(b)(1) Evaluation would be an even smaller percentage of the total loss. Also, these features provide many of the environmental benefits of this project. They would retard the inevitable degradation of the aquatic environment that would occur under without-project conditions. Thus, disposal of dredged or fill material as part of the overall plan for the Atchafalaya Basin Floodway System would add to the cumulative loss of habitat in Louisiana, but this amount of loss and/or conversion of habitats is acceptable in the overall public interest.

(g) Determination of Secondary Impacts. Secondary impacts of these features include the benthos that would be destroyed during constructin of the levees and access canal for the Buffalo Cove unit. Management units, in combination with the sediment control features, would limit slightly the amount of sedimentation occurring in backswamp areas and help to preserve the depth and extent of existing aquatic areas. These features would have a limited efficiency with management units contributing very little, and appreciable sedimentation within the management units would still be expected to occur.

III. FINDINGS OF COMPLIANCE FOR MANAGEMENT UNITS.

a. No significant adaptations of the guidelines were necessary for this evaluation.

b. An alternative to the previously described management unit concept was a plan by which each unit would have controlled inlets and outlets, navigation locks, and pumping stations. This alternative was eliminated from further consideration because preliminary estimates indicated that construction, operation and maintenance costs would be far greater than with other alternatives. No alternative disposal method or site is under consideration, since little adverse impact is expected under the selected plan.

c. Each of the work items listed in Section I.d. would likely cause a noticeable rise in turbidity levels in the immediate vicinity of the work site. These levels would return to normal soon after construction was complete. Since no numerical standards exist for turbidity or suspended sediment, a mixing zone could not be defined for these parameters. On a qualitative basis, no violations would be expected. There is no evidence from available data that any other regulated parameter would occupy a large enough portion of the water column to inhibit movements of free-swimming and drifting organisms. On the basis of available data, there would be no significant violations of applicable State of Louisiana water quality standards associated with implementation of this project feature.

d. No violations of the Toxic Effluent Standards of Section 307 of the Clean Water Act would be expected.

e. The proposed discharge would not jeopardize the continued existence of any threatened or endangered species nor result in the destruction or adverse modification of any critical habitat.

f. No designated marine sanctuaries are in the project area.

g. The proposed disposal of dredged material would not result in significant adverse effects on aspects of human health and welfare such as: municipal and private water supplies, recreation and commercial fisheries, plankton, fish, shellfish, wildlife, and the above-mentioned special aquatic sites. There would be no significant adverse effects on life stages of aquatic animals or other wildlife dependent on aquatic ecosystems. Significant adverse effects on aquatic ecosystem diversity, productivity, and stability would not occur. Recreational, esthetic, and economic values would not be adversely impacted in a significant manner. On the whole, environmental values would be enriched.

h. Appropriate and practical steps taken to minimize potential adverse impacts of the discharge of material into aquatic ecosystems include using only those areas of wetlands necessary for project completion.

i. On the basis of the guidelines, the proposed disposal sites for the discharge of fill material are generally specified as complying with the requirements of these guidelines with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the affected aquatic ecosystem.

Channel Training WLO and LAR

I. PROJECT DESCRIPTION.

a. Location. The Atchafalaya Basin is a large, shallow depression lying within the deltaic plain of the Mississippi River in south Louisiana bounded on the south by the natural levee ridge of the old Teche course of the Mississippi (see Plate G-1). The Basin is drained by two outlets. The Lower Atchafalaya River (LAR) is a natural outlet with a design capacity of 1,200,000 cubic feet per second (cfs). It begins near Morgan City and flows southward to Atchafalaya Bay, a distance of 20 miles. Wax Lake Outlet (WLO) is a 16-mile dredged channel with a capacity of 300,000 cfs located 10 miles west of Morgan City. It extends from Sixmile Lake through the Teche Ridge to Atchafalaya Bay.

b. General Description. Channel training below Morgan City is a process that consists of dredging material from the channel and placing it in shallow water and marsh areas along the bank in intermittent mounds built to a grade to equal the average annual flood. These works would simulate the development of natural ridges. Once in place, the training works would confine more flow to the channel, which would not only tend to accelerate its development, but also reduce the overbank deposition occurring during the project life. These works, generally built along both banks of the LAR and WLO gulfward of the Gulf Intracoastal Waterway (GIWW), would not be completely confining. Gaps would be left between disposal areas to allow for some continued development of the overbank marshes. In addition, Bayou Shaffer would be closed near its junction with the GIWW. A 4-foot diameter pipe would be placed in the closure to allow some low water flows. The project flowlines for the final array of plans represent conditions 50 years in the future. Such projections must be based on subjective evaluations of future development. All studies of the Atchafalaya River to date have concluded that the delta will continue to move farther into the bay. As this occurs, it is assumed that what can be done above the mouth to help improve flow in the river now would also be applicable above the mouth of the river in the future. It is therefore possible that conditions would merit continuance of the channel training program as the mouth of the Atchafalaya River moves gulfward with time because of continued delta development. If this were to occur, an EIS supplement and a supplemental Section 404(b)(1) Evaluation would be prepared.

c. Authority and Purpose. This feature was authorized by the Flood Control Act of 1928, as amended by subsequent authorizations. Senate and House resolutions in 1972 authorized development of a comprehensive plan for preservation and management of water and land resources in the Atchafalaya Basin. In 1976, the Chief of Engineers authorized a post-authorization study to address alternate plans to accomplish authorized purposes of the Atchafalaya Basin Floodway project. The attached Main Report recommends that the Chief of Engineers approve implementation of this feature. Two major changes are occurring in the outlets to the Basin. The WLO is enlarging rapidly and capturing a larger and larger percentage of the combined outlet flow. It is expected to grow from its present 38,000 square feet (sf) cross section to 51,000 sf by 2030, and to capture 50 percent of the combined flow, if no actions are taken. On the other hand, the LAR is diminishing in cross section and could have a cross section of 47,000 sf by 2030 (compared to its present section of 69,000 sf). The LAR is filling more rapidly than the WLO is growing, so the combined outlet capacity is decreasing. The design capacity is 1,500,000 cfs; the present capacity is only 850,000 cfs and it will decrease further under without-project conditions. The outlet flow distribution control described earlier would prevent capture of the LAR by the WLO and would cause some increase in outlet capacity. The channel training features would also increase outlet capacity. The channel training works would also reduce the project flood flowline at Morgan City by about one foot.

d. General Description of Dredged or Fill Material.

(1) General Characteristics of Material. The channel training material would be predominantly sand with varying proportions of silt and clay. The Bayou Shaffer closure material would be hydraulic clay fill, having low plasticity and permeability.

(2) Quantity of Material. It is estimated that 4.7 million cubic yards of material would be required for the training works. The Bayou Shaffer closure would require about 650,000 cubic yards of unconfined fill material.

(3) Source of Material and Disposal Methods. The channel training material would be hydraulically dredged from the adjacent channels. Bayou Shaffer would be closed using hydraulic clay material from a nearby, but currently undesignated, source.

e. Description of Proposed Discharge Sites.

(1) Location (map) Plates G-17 to G-19 illustrate the location of the disposal mounds and the Bayou Shaffer closure.

(2) Size of Disposal Areas and Types of Habitat. Construction of the channel training works would require the dredging of approximately 31 miles along the banks of the WLO and LAR. The acreages of disposal sites are indicated in Table G-11-17. The closure at Bayou Shaffer would cover less than 10 acres.

(3) Type of Site (confined, unconfined, open water). The discharged dredged material for channel training would not be confined either for the channel training works or for the Bayou Shaffer

closure. Each mound of material for channel training would gradually spread to cover an estimated 18 acres. The hydraulic material for the Bayou Shaffer closure would be placed in open water in an unconfined state unless soil tests indicated potential for significant erosion of the submerged material.

(4) Timing and Duration of Discharge. Construction of channel training works would take approximately 12 months and be done during the low water period. The initial filling of Bayou Shaffer would require about 6 weeks, during moderate to low water. After periods of about three and four years following original placement, the closure would be shaped to interim and final cross sections by dragline.

TABLE G-11-17
HABITAT TYPE OF DISPOSAL AREAS

Location	Miles of Dredging	Habitat Type of Disposal Area			
		Cypress-Tupelo	Early Successional Bottomland Hardwoods	Fresh Marsh	River (Shallow shore)
East Bank LAR	8	320	380		100
West Bank LAR	15	380	500	160	350
East Bank WLO	4		240		160
West Bank WLO	4		300		100
TOTAL	31	700	1420	160	710

f. Description of Disposal Method. Construction of channel training works would be accomplished by using a hydraulic dredge to pump material from the existing channel bottom areas into adjacent shallow water bottoms or stream banks. The Bayou Shaffer closure would also use a hydraulic dredge. The crown portion of the hydraulically placed closure section would be shaped after the initial fill had been in place for about 3 years. The shape-up would be in two stages, consisting of an initial dragline shaping followed by a final dragline shaping about one year later.

II. FACTUAL DETERMINATIONS.

a. Physical Substrate Determinations.

(1) Effects on Substrate Elevation and Slope. For channel training, the pumped material would be allowed to spread freely to the angle of repose, estimated to be one vertical on 40 horizontal. The elevation of the placed material above existing ground would be limited to a height sufficient to confine average annual peak flows and could vary from 0.5 to 6.8 feet with an approximate average depth of 3 feet. This would result in an irregular series of relatively low mounds of dredged material, roughly parallel to the channels, which would simulate the formation of natural levees. The Bayou Shaffer closure would be built to a matching elevation.

(2) Effects on Sediment Type. The dredged material would be of similar grain size to the existing bank material, predominantly sand with varying proportions of silt and clay.

(3) Effects on Dredged/Fill Material Movement. Considerable spreading and settling of the material would be expected, however, areas selected for dredging would be those with coarser grain sizes, which would maximize natural angles of repose, thereby minimizing the movement of material and the area needed for disposal. Some sorting and dispersal of fines would result from ambient water circulation and occasional flooding by headwater flows or tropical storms. Some of the unconfined material utilized to fill Bayou Shaffer would slough from the submerged embankment into the bayou unless measures to confine the material were taken.

(4) Physical Effects on Benthos. Riverine habitat in the WLO and LAR is slightly more productive than in the Atchafalaya River above Morgan City because both these water bodies have a high proportion of wide, shallow areas. These shallows would harbor an infauna of chironomids, tubificid worms, Asiatic clams and other groups. Blue crabs and river shrimp would also be present in large numbers. The benthos in the fresh marsh would consist of fauna similar to that in the river, but snails would be more common and organisms would exist in greater numbers. Although cypress-tupelo swamps are generally rich in numbers and diversity of benthos, the swamps immediately adjacent to the river would be likely to have fewer than normal species and numbers because of the constant turbidity and wave action caused by passing vessels. The early successional bottomland hardwoods would have no resident benthic populations, but would harbor a seasonal benthos of chironomids and isopods similar to those present in swamps. Benthic organisms in the 710 acres of riverine habitat, the 160 acres of fresh marsh, the 1420 acres of early successional bottomland hardwoods and the 700 acres of cypress-tupelo swamps would be destroyed by disposal of dredged material. Once the construction was completed, the channel training works would

revegetate with early successional bottomland hardwoods. The perimeters of the mounds would recolonize with a riverine benthos and the upper portions would receive seasonal benthic use.

(5) Actions to Minimize Impacts. The channel training mounds along the LAR and WLO would be placed so as to minimize the amount of marsh destroyed. A dike or cofferdam in the Bayou Shaffer channel would be needed to prevent significant erosion of hydraulic fill material into the water column if soil tests indicated significant erosion potential.

b. Water Circulation, Fluctuation and Salinity Determinations.

(1) Effects on Water.

(a) Salinity. As long as the major bayous exiting from the LAR, such as Chicken Island and Big Wax Bayous, and those leaving the WLO, such as Little Wax Bayou and Bayou Blue, are left open, salinity variations should remain similar to those which exist at present. The amounts of freshwater flowing down the WLO and LAR would prevent salinity intrusion into the fresh marshes.

(b) Water Chemistry. Observed data from a water quality monitoring program conducted in the Atchafalaya Floodway area downstream of Morgan City in 1975 and 1976 indicated little variation in pH of waters: at and near dredging sites and confined disposal areas; and prior to, during, and after dredging. Localized and short-duration increases of alkalinity in the water column would be expected after the introduction of dredged material.

(c) Clarity. Construction activities would significantly reduce water clarity at each work site and downstream because of increased sediment loads. Following construction clarity would improve, however, the greater efficiency of the trained channel would lead to normally higher sediment loads and less clarity.

(d) Color. Water color would be affected similarly to water clarity.

(e) Odor and Taste. No significant effects would be expected.

(f) Dissolved Gas Levels. The dissolved gas of major concern is oxygen. Impacts of dissolved oxygen (DO) levels are discussed in section II.c.(2)(b).

(g) Nutrients. Channel training works below Morgan City would be expected to cause elevation of nutrient levels in the disposal sites. Unless, however, extreme combinations of two or more contributing factors, including low DO, high pH, high temperature, low water volume in the mixing zone, and high rate of dredged material disposal are present, there should not be any significant long-term adverse water column effects due to elevated nutrient concentrations.

(h) Eutrophication. Eutrophic conditions would not be expected in the LAR or WLO despite temporarily increased nutrient levels, because of the simultaneous increase in turbidity. Marsh areas could, however, experience eutrophication since, at present, they might be nutrient limited.

(2) Current Patterns and Circulation. Channel training works would reduce sheet flow to the adjacent wetlands during periods when flow in the LAR and WLO exceeded the present bankfull stage. The reduction would be most significant below the average annual flood stage. When the outlets were within their banks the channel training works would have no impact on circulation. Reduction of the sheet flow of water and sediment would retard the growth of land and the filling of bayous and ponds adjacent to the outlets. It should be remembered that natural channel and levee development would eventually produce banks similar to channel training works. Channel training would hasten their development. Not only would training works physically reduce overflow of water and sediments, but they would increase the velocity of water, which would also reduce the amount of sediment carried to the adjacent marshes. An additional integral part of channel training below Morgan City is the closure of Bayou Shaffer. Currently, Bayou Shaffer conveys about 12 percent of the flow that passes Morgan City. The closure of Bayou Shaffer would require all of this flow to be conveyed by the Lower Atchafalaya River.

(3) Normal Water Level Fluctuations. This feature would contribute to a lowering of the flowline in the Lower Atchafalaya Basin Floodway. Channel training of the outlets and closure of Bayou Shaffer would reduce the flowline at Morgan City and Wax Lake Outlet by about 1.0 foot. The reduction in flowline would average about 0.5 foot for the EABPL and WABPL. Channel training would also accelerate the time period in which the floodway would become capable of conveying the project flood. This acceleration would be achieved by dredging to build the training works, which in itself would enlarge the channel, and by a reduction in overbank deposition in the early years of the project.

(4) Salinity Gradients. See section II.b.(1)(a) for more detailed discussion. Construction of the channel training works below Morgan City would help to preserve existing salinity gradient patterns more than if no action were taken, which would lead to more rapid freshening of East and West Cote Blanche Bay and slower freshening of the Terrebonne marshes.

(5) Actions That Will Be Taken To Minimize Impacts. Careful control over placement of the material would be exercised to utilize shallow water bottoms adjacent to the channel rather than using existing marsh, whenever possible. In addition, every attempt would be made to avoid filling existing connecting channels which would continue to carry sediment and nutrients to the marshes.

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site. Suspended particulate and turbidity levels would increase significantly during construction, both at the site and downstream. By reducing river overflow these project features would decrease sediment flow into overbank areas and thereby maintain higher particulate levels in the river. The increased velocities and magnitudes of flow would contribute toward attaining a higher suspended particulate and turbidity level as the norm. After closure, Bayou Shaffer would be less turbid than at present.

(2) Effects on Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Light penetration would be temporarily reduced in the LAR and WLO areas due to increased suspended solids and turbidity levels during dredging and construction of the intermittent mounds in adjacent wetlands. Coarse solids which were resuspended in the water column during dredging and placement of dredged material would settle from suspension in a relatively short period. Furthermore, the brackish salinity of the lower waters might induce coagulation and flocculation of much of the finely divided and colloidal-sized material suspended in the water column during dredging operations. However, the increased velocity and magnitude of flow within the river would be expected to maintain reduced light penetration into the future. Post-construction light penetration in Bayou Shaffer would be greater than at present.

(b) Dissolved-Oxygen. Dissolved-oxygen concentrations in wetland areas are generally dependent upon temperature and flow conditions. During periods of high flow a sufficient supply of freshwater reaches these areas and dissolved-oxygen concentrations are maintained at a high level. During the low-flow summer months smaller quantities of water reach these areas. Dissolved-oxygen concentrations decline to low levels in the wetland areas because of the increased effect of organic degradation and the lack of a sufficient supply of oxygen from the river or from photosynthetic production. By leaving gaps in the channel training works, natural flow cycles controlling DO in the overbank areas would be preserved as much as possible. Oxygen-demanding sediments within the dredged mounds of material might cause localized DO problems during low flow summer conditions. However, the predominance of sandy material in the WLO and LAR main channels indicates that the oxygen demand of these sediments should generally be small. The closure of Bayou Shaffer would permanently alter flow conditions in and downstream from that bayou which could significantly reduce DO levels in that area.

(c) Toxic Metals and Organics. Toxic metals and harmful organics are discussed in Section II.d.

(d) Pathogens. No effect as a result of proposed activities.

(e) Esthetics. Higher turbidity levels in the river, Bayou Shaffer, and surrounding wetlands would detract from esthetic appeal. Until the mounds created by dredged material disposal became vegetated, they would also be expected to detract from the area's esthetics.

(3) Effects on Biota.

(a) Primary Production. Primary production is limited in the turbid LAR and WLO. Diatoms and green algae are the most common groups and usually occur in greater numbers when the turbidity drops during the low-water period. Construction of channel training works and the closure of Bayou Shaffer would significantly increase turbidity for the construction periods and thus reduce primary productivity during the period when it was highest. However, this effect would only be felt during the construction period and phytoplankton populations should regain their usual numbers and diversity the next year. The turbidity would also reduce benthic primary productivity in the shallow riverine waters during construction. On completion of the closure of Bayou Shaffer, primary productivity would increase in the entire bayou due to reduction of turbidity.

(b) Suspension/Filter Feeders. Turbidity would interfere with feeding by suspension and filter feeders, but the impact should be temporary and limited to the construction period and the vicinity of the construction site. Mobile benthos would probably vacate the area until conditions returned to normal. Some mortality among sedentary species would be expected, however, recolonization should be fairly rapid.

(c) Other Organisms Affected by Turbidity. No significant effect would be expected on sight feeding organisms; they would vacate the turbid area and return once turbidity became reduced. The river fish community is adapted to high ambient levels of turbidity.

(4) Actions Taken to Minimize Impacts. Construction during low water would minimize the turbidity engendered by the feature.

Confining dikes or cofferdams should be employed at the Bayou Shaffer site unless the fill material proves to be sufficiently stiff to withstand significant erosion by water movements. A silt curtain might be used as a turbidity control device for upper water layers. The culvert through the Bayou Shaffer closure would prevent serious dissolved oxygen deficits downstream.

d. Contaminant Determinations. The Atchafalaya River is not believed to harbor dangerous levels of toxic substances. A sampling program conducted by the New Orleans District, Corps of Engineers in 1975 included five sites (see Plates G-17 and G-18) in the immediate vicinity of the proposed channel training works. Tables G-11-18 through G-11-23 list the measured concentrations of toxic substances and other parameters in water and sediment samples and elutriate mixtures. Also shown are current EPA criteria for chronic exposure of aquatic life to toxic pollutants. Although a limited number of criteria exceedences occurred, no consistent pattern of contaminant releases was shown by the elutriate tests, which indicate conditions that would exist immediately after discharge of hydraulically dredged material into a water body. Some parameters, notably cyanide, cadmium, and chromium, could not be detected at levels comparable to EPA criteria, but are not believed to vary significantly from the other parameters in their tendencies to remain in solution after dredging occurs. These data, together with the temporary and localized effects upon particular segments of the ecosystem, do not suggest any significant adverse impacts.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton. As described above, phytoplankton populations in this large, turbid river system are generally low execpt during low water. Zooplankton populations are also somewhat limited. Rotifers and light-bodied cladocerans and copepods dominate the plankton and generally peak during high water periods. The cypress-tupelo swamps adjacent to the LAR have somewhat lower zooplankton numbers and diversity than swamps in the basin proper because of the turbidity caused by vessel traffic. The zooplankton in fresh marsh would be similar to those in the river. When the early successional habitat is flooded it also harbors zooplankton populations similar to those in the river. Construction of channel training works would permanently remove 700 riverine acres, 710 acres of cypress-tupelo, and 160 acres of fresh marsh from the aquatic ecosystem except at highwater. Approximately 1420 acres of early successional bottomland hardwoods that are seasonal aquatic habitat would be part of the aquatic system only during high water. Turbidity impacts to plankton are discussed in Section II.c.(3) above.

(2) Effects on Benthos. The effects of burial on benthos are discussed in section II.a.(4) above and the effects of turbidity are discussed in section II.c.(3)(b) above. The numbers and diversity

TABLE G-11-18

WATER AND SEDIMENT DATA
SITE NO. 1, 1975 (TWO MEASUREMENTS)
GIWW AT WAX LAKE OUTLET (WEST SIDE)

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Residue Lost on Ignit.					21,400/17,600
Residue, Suspen. 110C	68,000/132,000				
Residue, Tot. Nonfil, 105C	42,000/50,000				
Residue, Vol. Susp.	2,000/22,000				
Oil and Grease		0/2,000			1/1
Chlorides					
COD	10,000/21,000		24,000/12,000		9,500/7,400
DKN		660/260			
TKN			2,100/7,300		400/270
Cyanide	0/10		30/0	3.5	0/0
Phenols	13/15		11/6	2,600	
Calcium					
Magnesium					
Manganese					
Iron				1,000	
Mercury		0.0/0.0	0.0/0.0	0.20	0.10/0.07
Lead		0/1	2/1	3.8*	10/20
Zinc		0/8	10/1	47	27/28
Chromium		0/0	0/0	0.29	5/6
Cadmium		0/0	0/0	0.025*	1/1
Copper		3/3	5/9	5.6	6/6
Nickel		0/1	1/2	96*	5/10
Arsenic		1/1	2/1	40	0/0
2,4-D	0.03/0.03			370	
2,4,5-T	0.01/0.00				
DDD					0.0016/0.0011
DDE					0.0005/0.0004
DDT					0.0005/0.0005
Dieldrin					0.0003/0.0002
Endrin					0.0/0.0002
Silvex	0.01/0.00				

TABLE G-11-19

WATER AND SEDIMENT DATA
SITE NO. 2, 1975
BAYOU BOEUF AT BAYOU SHAFFER

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Residue Lost on Ignit.					9,930/17,800
Residue, Suspen. 110C	124,000/96,000				
Residue, Tot. Nonfil, 105C	104,000/62,000				
Residue, Vol. Susp.	18,000/8,000				
Oil and Grease	1,000/0.0				1/1
Chlorides					
COD	9,000/9,000		12,000/11,000		2,200/11,000
DKN			340/390		
TKN		300/410			130/260
Cyanide	0.00/10		0/0	3.5	0/0
Phenols	18/7		12/11	2,600	
Calcium					
Magnesium					
Manganese					
Iron				1,000	
Mercury		0.0/0.0	0.0/0.0	0.20	0.09/0.10
Lead		0/0	0/1	3.8*	10/10
Zinc		6/10	4/0	47	20/21
Chromium		0/0	0/0	0.29	4/4
Cadmium		0/0	0/0	0.025*	1/1
Copper		2/8	8/2	5.6	3/5
Nickel		2/0	1/0	96*	5/5
Arsenic		3/0	0/1	40	0/0
2,4-D	0.06/0.06			370	
2,4,5-T	0.01/0.01				
DDD					0.0002/0.0
DDE					0.0001/0.0
DDT				0.0010	0.0002/0.0
Dieldrin				0.0019	0.0001/0.0
Endrin				0.0023	0.0/0.0
Silvex	0.01/0.01				

*Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.

TABLE G-11-20

WATER AND SEDIMENT DATA
SITE NO. 3, 1975
BAYOU BOEUF (UPSTREAM DURING DREDGING, MEAN)

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Residue Lost on Ignit.					
Residue, Suspen. 110C	44,000				
Residue, Tot. Nonfil, 105C	50,000				
Residue, Vol. Susp.	10,000				
Oil and Grease	200				
Chlorides		35,000			
COD	260,000				
DKN		1,450			
TKN					
Cyanide	0			3.5	
Phenols	2.5			2,600	
Calcium		39,200			
Magnesium		12,800			
Manganese					
Iron		3.3		1,000	
Mercury	0.10	0.07		0.20	
Lead	10.3	5.2		3.8*	
Zinc	25	4.3		47	
Chromium	8.3	0		0.29	
Cadmium	0	0		0.025*	
Copper	5.2	2.5		5.6	
Nickel	3.7	0		96*	
Arsenic	2	1		40	
2,4-D	0.038			370	
2,4,5-T	0.07				
DDD	0				
DDE	0				
DDT	0			0.0010	
Dieldrin	0.003			0.0019	
Endrin	0.005			0.0023	
Silvex					

*Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.

TABLE G-11-21

WATER AND SEDIMENT DATA
SITE NO. 4, 1975
EAST SIDE LOWER ATCHAFALAYA RIVER, MILE 118

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Residue Lost on Ignit.					7,750/4,730
Residue, Suspen. 110C	140,000/160,000				
Residue, Tot. Nonfil, 105C	110,000/128,000				
Residue, Vol. Susp.	28,000/14,000				
Oil and Grease	1,000/1,000				1/1
Chlorides					
COD	13,000/25,000		11,000/5,000		2,400/1,000
DKN		260/310	310/320		
TKN					100/80
Cyanide	0/0		0/10	3.5	0/0
Phenols	12/7		9/10	2,600	
Calcium					
Magnesium					
Manganese					
Iron				1,000	
Mercury		0.0/0.0	0.0/0.0	0.20	0.03/0.04
Lead		3/1	2/1	3.8*	10/10
Zinc		0/6	0/0	47	15/12
Chromium		0/0	0/0	0.29	0/2
Cadmium		0/0	0/0	0.025*	1/1
Copper		4/5	3/3	5.6	2/2
Nickel		2/0	1/0	96*	5/5
Arsenic		1/1	1/0	40	1/0
2,4-D	0.04/0.04			370	
2,4,5-T	0.01/0.01				
DDD					0.0/0.0
DDE					0.0002/0.0
DDT				0.0010	0.0003/0.0
Dieldrin				0.0019	0.0/0.0
Endrin				0.0023	0.0/0.0
Silvex	0.01/0.01				

*Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.

TABLE G-11-22

WATER AND SEDIMENT DATA
SITE NO. 5, 1975
WEST SIDE LOWER ATCHAFALAYA RIVER, MILE 118

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Residue Lost on Ignit.					19,500/33,400
Residue, Suspen. 110C	120,000/192,000				
Residue, Tot. Nonfil, 105C	56,000/200,000				
Residue, Vol. Susp.	32,000/8,000				
Oil and Grease	0/0				1/1
Chlorides					
COD	14,000/8,000		8,000/7,000		9,500/9,800
DKN		350/310	230/210		
TKN					360/540
Cyanide	0/0		0/0	3.5	0/0
Phenols	11/12		7/6	2,600	
Calcium					
Magnesium					
Manganese					
Iron				1,000	
Mercury		0.0/0.0	0.0/0.0	0.20	0.05/0.07
Lead		0/1	1/1	3.8*	10/20
Zinc		10/0	10/0	47	32/33
Chromium		0/0	0/0	0.29	8/6
Cadmium		0/0	0/0	0.025*	1/1
Copper		25/4	2/8	5.6	8/12
Nickel		2/1	2/0	96*	10/10
Arsenic		1/0	1/0	40	3/3
2,4-D	0.03/0.06			370	
2,4,5-T	0.01/0.01				
DDD					0.0002/0
DDE					0/0
DDT				0.0010	0/0
Dieldrin				0.0019	0.0001/0
Endrin				0.0023	0/0
Silvex	0.01/0.01				

*Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.

TABLE G-11-23

WATER AND SEDIMENT DATA
SITE NO. 6, 1975
GIWW AT LOWER ATCHAFALAYA RIVER

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Residue Lost on Ignit.					30,400/53,000
Residue, Suspen. 110C	88,000/48,000				
Residue, Tot. Nonfil, 105C	24,000/244,000				
Residue, Vol. Susp.	12,000/18,000				
Oil and Grease	-/0				1/1
Chlorides					
COD	13,000/11,000		26,000/15,000		20,000/37,000
DKN		210/320	3,400/3,700		
TKN					700/1,300
Cyanide	0/0		10/0	3.5	0/0
Phenols	10/11		12/6	2,600	
Calcium					
Magnesium					
Manganese					
Iron				1,000	
Mercury		0.0/0.0	0.0/0.0	0.20	0.11/0.11
Lead		1/0	0/1	3.8*	10/20
Zinc		10/10	0/6	47	48/57
Chromium		0/0	0/0	0.29	10/11
Cadmium		0/0	0/0	0.025*	1/1
Copper		4/7	2/9	5.6	12/20
Nickel		2/1	1/0	96*	10/15
Arsenic		0/0	1/1	40	4/3
2,4-D	0.04/0.04			370	
2,4,5-T	0.01/0.01				
DDD					0.0021/0.0018
DDE					0.0007/0.0
DDT				0.0010	0.0/0.0
Dieldrin				0.0019	0.0001/0.0
Endrin				0.0023	0.0/0.0
Silvex	0.01/0.01				

*Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.

of benthic organisms in Bayou Shaffer below the closure would increase as the current decreased. The culvert should allow enough flow to prevent dissolved-oxygen problems.

(3) Effects on Nekton. The riverine waters of the WLO and LAR support fairly extensive fish populations. The most common species are catfish, shad, and mullet. These waters, being adjacent to Atchafalaya Bay, are a major thruway for many estuarine species, such as anchovies and menhaden, that utilize marshes and ponds as a nursery area. The wide, shallow portions of the WLO and LAR also furnish nursery space to young fish. The covering of 710 acres of river bottoms would have an impact by removing these acres from aquatic productivity. The perimeters of the channel training mounds would furnish some shallow water areas. The cypress-tupelo swamps adjacent to the LAR would harbor typical swamp fish such as bowfin, crappie and gar. The removal of 700 acres of these swamps from the aquatic ecosystem would have a minor adverse effect on aquatic productivity, because it would remove habitat and also the detritus and nutrients swamps produce. The fresh marshes along the LAR provide nursery and feeding habitat for numerous species of fish such as sheepshead minnows, bluegills, and anchovies. Filling of 160 acres of fresh marsh would destroy its feeding/spawning/nursery potential. The 1420 acres of early successional bottomland hardwoods that would be covered by channel training works are only seasonally flooded at the present. All channel training mounds would revegetate within a few years with young willows on top and marsh plants along the perimeter. This revegetation would return some of the area to the aquatic system, but the overall impact of this feature would be a slight reduction in aquatic productivity.

(4) Effects on the Aquatic Food Web. The filling of 160 acres of marsh, 710 acres of swamp, and 1420 acres of successional hardwoods would reduce their detrital input to the aquatic system. The training works would revegetate with early successional bottomland hardwoods, but these would be flooded less often than they are at present. Loss of this detritus should not be a significant adverse impact. Productivity in Bayou Shaffer would increase slightly after its closure because planktonic and benthic populations would multiply.

(5) Effects on Special Aquatic Sites.

(a) Sanctuaries and Refuges. Channel training works would markedly increase turbidity in upper portions of the Atchafalaya Delta Wildlife Management Area during construction and could produce slightly higher levels after construction.

(b) Wetlands. For purposes of this evaluation, all wooded habitats found in the proposed disposal areas (cypress-tupelo and early successional bottomland hardwoods) are considered wetlands. The proposed discharge would destroy existing vegetation, and plant succession would begin within a year. The disposal areas would become early successional bottomland hardwoods prior to 2030. Wetland values of the disposal areas would be reduced due to loss of cypress-tupelo habitat and the reduced flooding effected by the channel training works. The overall effects, considering the vast acreages of wetland and aquatic habitat in the basin, would be minor.

(c) Mudflats. At the present time, during low water and/or low tide, mudflats exist along the lower curves of the LAR. Channel training works would fill these flats and they would no longer serve as habitats for benthos or feeding areas for birds. The loss of these areas should not be significant because extensive mudflats are found a few miles south in Atchafalaya Bay.

(6) Wildlife Effects. Channel training works would replace 700 acres of cypress-tupelo with early successional bottomland hardwoods which would have less wildlife value, especially to wading birds. The loss of mudflats would also have a slight adverse impact on wading and shore birds. The channel training works would be placed in the vicinity of two wading bird rookeries near the confluence of Bayou Shaffer and the LAR. Since construction would be at low water, impacts on the nesting success should be minimal. Efforts would be made to avoid actual destruction of rookery sites by careful placement of channel training works. During construction, young and slow-moving animals in disposal areas would be destroyed, and others would be forced to move to adjacent areas where they would face increased intra- and inter-specific competition and might not survive.

(7) Effects on Endangered and Threatened Species. This feature would not cause any significant adverse impact on any endangered or threatened species nor on their critical habitat.

(8) Actions to Minimize Impacts. Careful placement of the channel training works should avoid significant adverse impact to rookeries, reduce the amount of marsh lost and avoid closing existing distributary channels.

f. Proposed Disposal Site Determinations.

(1) Mixing Zone Determinations. In view of the limited possibility of contamination, mixing zone calculations would not be necessary. Unknown or variable factors such as rates of discharge, quantities of dredged material, and indefinite chemical analyses would at any rate, make such a calculation unduly speculative. Qualitatively, it would be expected that turbidity levels would rise in the river and wetland areas; and DO levels might be reduced in wetland areas.

(2) Determination of Compliance with Applicable Water Quality Standards. Water quality standards are established at the state level (see Tables G-11-6 and G-11-6A). Louisiana standards

include a limited number of parameters which in general do not reflect industrial pollution (chloride, sulfate, DO, pH, coliform bacteria, temperature, and total dissolved solids). With the possible exception of DO and turbidity none of these standards would be violated.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supply. No effects would be expected.

(b) Recreational and Commercial Fisheries. The covering of nearly 3,000 acres of riverine and wetland habitat would slightly decrease the numbers of recreational and commercial fish in the area. However, this should not significantly impact local fisheries.

(c) Water-Related Recreation. Channel training would close some existing channels, which would have a minor adverse impact on recreational boating. Closure of Bayou Shaffer would necessitate a one-mile longer trip for recreationists going from Morgan City to points south.

(d) Esthetics. The turbidity created by this feature would be unsightly during construction and the mounds and closure dam would not be esthetically pleasing until they revegetated.

(e) Effects on Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. Channel training of the Atchafalaya River outlets would not directly impact the Atchafalaya Delta Wildlife Management Area but would increase flows through it, and construction would temporarily increase turbidity. There might be unknown archeological sites within this area. Specifications covering the work to be performed in constructing and maintaining the project features would provide for the preservation of any items of apparent historical or archeological interest.

(f) Determination of Cumulative Effects on the Aquatic Ecosystem. The channel training works below Morgan City are part of an overall comprehensive plan for the Atchafalaya Basin Floodway System. The plan would accomplish flood control objectives, which are of great importance in the Lower Mississippi Valley, and provide for preservation and enhancement of the very significant fish, wildlife, and other natural resources of the basin. Overall, then, the plan would result in preservation and enhancement of significant portions of the basin's aquatic environment, especially through environmental easements. The plan cannot, however, prevent large-scale changes in habitat, from aquatic to terrestrial, as the maturation of the Atchafalaya River continues. The total direct construction impacts of this entire project would result in the loss or modification of approximately 6,000 acres of cypress-tupelo, 9,000 acres of mid-to-late successional bottomland, and 6,000 acres of early successional bottomland hardwoods. This compares to approximately 451,000; 332,000; and 100,000 acres, respectively, of these habitat types within the project-affected area (Table 6-7, page EIS-110, Volume 1). On a percentage basis, construction of the entire project would cause a respective loss of 1.3, 2.7, and 6.0 percent, of these habitat types. The terrestrial habitat loss caused by the feature considered in this 404(b)(1) Evaluation would be an even smaller percentage of the total loss. Channel enlargement in the WLO and LAR would reduce the diversity of subaqueous conditions in those waterways. The channels would have more uniform bank habitat, flow patterns, temperature gradients, and flood stages. Shifting bed loads, areas of scouring and deposition, and increased particulate loads would be expected to continue to exist. These occurrences would inhibit normal aquatic growth. The delta area at the river mouth would aggrade slightly more rapidly than present with fine sand and silt layers. Increased channel capacity would reduce overflow and use of the floodplain as a source of organic nutrients and detritus. Thus, disposal of dredged or fill material as part of the overall plan for the Atchafalaya Basin Floodway System would add to the cumulative loss of habitat in Louisiana, but this amount of loss and/or conversion of habitats is acceptable in the overall public interest.

(g) Determination of Secondary Impacts. All existing trees on the disposal areas would be killed (see Table G-11-17 for habitat types). The areas would revegetate as early successional bottomland hardwoods with a small amount of marsh occurring on the perimeter of the mounds. The major secondary impact would be reduction of overbank flows which would decrease the amount of nutrients and sediment being supplied to adjacent wetlands, mainly fresh marshes. By leaving most existing distributary channels open, existing channel flows to adjacent areas would be maintained. Quantification of the impact of reducing overbank flows is difficult. The area between the LAR and Bayou Shaffer has been losing wetlands and gaining scrub/shrub and open water in the period between 1956 and 1978. This trend would be expected to continue and slightly accelerate due to channel training. The marshes between the WLO and LAR and adjacent to each waterway are presently losing acreage at a lower rate than marshes farther away from these waterways. This lower loss rate is due to the sediment nourishment they receive. Channel training works, by reducing overflow, would reduce the amounts of sediment these marshes receive, but it is not possible to quantify this impact. The Atchafalaya Bay modeling effort currently being conducted by WES is expected to develop a tool to determine how the proposed channel training works would affect future delta building, salinities, and overbank sedimentation.

III. FINDINGS OF COMPLIANCE FOR CHANNEL TRAINING BELOW MORGAN CITY.

a. No significant adaptations of the guidelines were necessary for this evaluation.

b. Channel training below Morgan City has no alternative except no-action. The no-action plan would be most environmentally desirable, but channel training was chosen because it would produce a lowered flowline, and therefore levee raising would be less costly.

c. The Atchafalaya River, along its entire length, has been designated by the State of Louisiana for primary and secondary contact recreation and propagation of fish and wildlife, and for domestic water supply above Bayou Boeuf. The river water is characteristically highly turbid, and also is high in suspended solids, dissolved oxygen, nitrogen, and phosphorus. Waters leaving the floodway through the Lower Atchafalaya River and Wax Lake Outlet provide continuing nourishment to the estuarine and marine areas of the lower basin. Atchafalaya Basin waters are relatively free of toxic substances, including heavy metals and pesticides. Each of the channel training works and the Bayou Shaffer closure would likely cause a noticeable rise in turbidity levels in the area. Since no numerical standards exist for turbidity or suspended sediment, a mixing zone could not be defined for these parameters. On a qualitative basis no violations would be expected. There is no evidence from available data that any other regulated parameter would occupy a large enough portion of the water column to inhibit movements of free-swimming and drifting organisms. On the basis of available data, there would be no significant violations of applicable State of Louisiana water quality standards associated with implementation of this project feature.

d. No violations of the Toxic Effluent Standards of Section 307 of the Clean Water Act would be expected.

e. The proposed discharge would not jeopardize the continued existence of any threatened or endangered species nor result in the destruction or adverse modification of any critical habitat.

f. No designated marine sanctuaries are in the project area.

g. The proposed disposal of dredged material would not result in significant adverse effects on aspects of human health and welfare such as: municipal and private water supplies, recreation and commercial fisheries, plankton, fish, shellfish, wildlife, and the above-mentioned special aquatic sites. There would be no significant adverse effects on life stages of aquatic animals or other wildlife dependant on aquatic ecosystems. Significant adverse effects on aquatic ecosystem diversity, productivity, and stability would not occur. Recreational, aesthetic, and economic values would not be adversely impacted in a significant manner.

h. Appropriate and practical steps taken to minimize potential adverse impacts of the discharge of material into aquatic ecosystems include using only those areas of wetlands necessary for project completion and leaving all possible existing channels open. Placement of material in shallow water areas should be performed during low water period to minimize erosion. If engineering tests of hydraulic clay fill material for the Bayou Shaffer closure indicate significant erosion potential, dikes or cofferdams should be provided to prevent direct contact of the dredged material with flowing water.

i. On the basis of the guidelines the proposed disposal sites for the discharge of fill material are generally specified as complying with the requirements of these guidelines, with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the affected aquatic ecosystem.

Maintenance Dredging

I. PROJECT DESCRIPTION.

a. Location. The proposed maintenance dredging would occur at a number of sites within the Atchafalaya Basin Floodway System in south central Louisiana.

b. General Description. The Atchafalaya River is formed near Simmesport, Louisiana, where Old River and Red River meet. The river then flows about 140 miles to Atchafalaya Bay, an arm of the Gulf of Mexico. The Atchafalaya River is the major distirbutary of the Mississippi River, and the basin through which it flows serves as a major floodway during times of high flow. The Atchafalaya Basin Floodway System consists of three separate floodways, the West Atchafalaya and Morganza Floodways to the north, and the Lower Atchafalaya Basin Floodway to the south. The Lower Atchafalaya Basin Floodway begins about the latitude of Krotz Springs and extends southward to the vicinity of Morgan City. Below the latitude of Morgan City, two outlets, the Wax Lake Outlet and the Lower Atchafalaya River, pass water through to Atchafalaya Bay and eventually to the Gulf of Mexico. More detailed descriptions of the project area are in the Main Report and Environmental Impact Statement (EIS) and in the Technical Appendices. Plate G-1 is a General Map of the area.

c. Authority and Purpose. The proposed dredging is authorized by the Flood Control Act of 15 May 1928, Public Law 391-70, as amended, and as modified by subsequent authorizations. The proposed work consists of dredging at the following locations: Old River Lock Tailbay, Three Rivers (mile 0 Atchafalaya River), McCrea Landing (mile 12 Atchafalaya River). Below Bayou Sorrel (alternate Route GIWW), East Freshwater Distribution Channel, East and West Access Channels, Grand and Sixmile Lakes, and Berwick Bay Harbor and Berwick Lock Forebay. The overall purpose of this maintenance dredging is to maintain authorized depths for navigation. Brief descriptions of the individual projects follow:

(1) Old River Lock Tailbay. Old River Lock is located in a land cut approximately 1.5 miles long which provides for navigation between the Mississippi River and the Red and Atchafalaya River systems. The navigation channel is authorized to be maintained at 12 feet deep and 125 feet wide.

(2) Three Rivers (mile 0 Atchafalaya River). Three Rivers maintenance dredging would be in Old River at the juncture of Old, Atchafalaya, and Red Rivers, and would extend along the Old River channel about 3,000 feet. The navigation channel is authorized to be maintained at 12 feet deep and 125 feet wide.

(3) McCrea Landing. McCrea Landing is a bar crossing about 3,500 feet long in the Atchafalaya River at mile 12. The navigation channel is authorized to be maintained at 12 feet deep and 125 feet wide.

(4) East Freshwater Distribution Channel. The site of this work would be located within the Atchafalaya Basin Floodway in Iberville and St. Martin Parishes. The 9-mile channel follows the course of the Upper Grand River westward from the East Atchafalaya Basin Protection Levee to the intersection with Little Tensas Bayou; thence southerly down this bayou to its juncture with the Blind Tensas Cut--Lake Mongoulois segment of the Atchafalaya Basin main channel. The channel would be maintained to a depth of minus 9 feet NGVD and 80 feet wide (to provide a cross sectional area of 1,000 square feet below low water).

(5) East and West Access Channels. The East and West Access Channels connect laterally to the main channel of the Atchafalaya River in the vicinity of river Mile 78 (1963 mileage). The 12-mile-long East Access Channel begins in the East Atchafalaya Basin Protection Levee borrow canal at the south end of Bayou Sorrel lock and proceeds northerly to the intersection of Bayou Sorrel. A one-mile-long bypass channel was dredged to avoid the first oxbow in Bayou Sorrel. The channel then follows the alinement of Bayou Sorrel westerly for about 6 miles, where it departs Bayou Sorrel and enters a straight dredged channel approximately 2.5 miles long, terminating in the Big Bayou Chene segment of the Atchafalaya River main channel. The West Access Channel begins about one mile north of the terminus of the East Access Channel in Big Bayou Chene. The West Access Channel follows generally the alinement of Bayou Chene westerly into Bayou Crook Chene, through Alligator Bayou, into Little Gonsoulin Bayou and intersects Lake Fausse Pointe Cut. (There are several sections in this segment which have been dredged outside of the natural watercourse to improve channel alinement.) The West Access Channel continues down Lake Fausse Pointe Cut about one mile, then proceeds to its end at Dauterieve Landing on Grand Bayou. East and West Access Channels would be maintained to a depth of minus 7 feet NGVD and 80 feet wide, and provide for navigational access across the Atchafalaya Basin to waterways in the vicinity of the East and West Atchafalaya Basin protection levees.

(6) Below Bayou Sorrel (Alternate Route GIWW). Shoaling in the first mile or two of the alternate GIWW below Bayou Sorrel lock occurs as stages of the Atchafalaya River fall. Maintenance dredging would be required to maintain adequate depths for navigation. The channel is authorized to be maintained at 12 feet deep and 125 feet wide.

(7) Grand and Sixmile Lakes. Proposed maintenance of the navigation channel through Grand and Sixmile Lakes would consist of

dredging to minus 12 feet NGVD and 125 feet wide from about Mile 105 to Mile 114. Normal maintenance dredging procedures involve dredging up to four feet below the authorized depth as a practical achievement of "advance maintenance."

(8) Berwick Bay Harbor and Berwick Lock Forebay. Dredging in Berwick Bay Harbor would consist of removal of shoal material riverward of a line approximately 25 feet collectively from the face of the docks to the minus 12-foot NGVD contour in the river on both the Berwick and Morgan City sides of the harbor. Dredging might be required on the Berwick side from about Mile 116.3 to Mile 118.9 (1963 mileage below the intersection of Red, Old, and Upper Atchafalaya Rivers on the Atchafalaya River). Dredging on the Morgan City side of the harbor might be required from about Mile 116 and extend along the harbor front into Bayou Boeuf (GIWW) and to the levee closure at the west end of Bayou Boeuf Lock. Approximately 1,800 feet of dredging might be required from the Lower Atchafalaya River across a tidal flat through the forebay of Berwick Lock (Mile 116.2 AR). Additional periodic dredging is required in the vicinity of Berwick Lock.

d. General Description of Dredged or Fill Material. The material to be dredged would consist of silts, clay, and fine-to-coarse-grained sand, and includes stumps, roots, and logs. Material dredged from the main channel of the Atchafalaya River would be predominantly sand (0.074 mm or greater). Off-channel ares, such as the distributary channels and GIWW Alternate Route, would contain greater percentages of silts and clays (less than 0.074 mm in diameter). About 2,170,000 cubic yards of material would be dredged annually.

e. Description of Proposed Discharge Sites.

(1) Location. Plate G-20 shows the general location of maintenance dredging sites. Plates G-21 through G-27 indicate specific locations where disposal would be placed. Table G-11-24 shows frequency of dredging at each site, the average annual dredging requirements, the general locations of disposal areas, and acreage and habitat types to be affected by discharge of dredged material.

(2) Size. Approximately 5,800 acres would be required for disposal of dredged material over the life of the project. The confined disposal sites are already in existence. Some have been utilized and others have never been disposed in.

(3) Types of Sites. The within-water disposal associated with dredging at Three Rivers, McCrea Landing, Grand and Sixmile Lakes, and Berwick Harbor and Lock would be unconfined. All other disposal sites would be diked with the clarified effluent returned to the nearest deepwater channel through flow control structures.

TABLE G-11-24

MAINTENANCE DREDGING

Location	Dredging Frequency	Average Annual Yardage (C.Y.)	Location of Spoil Disposl Areas	Acreage and Habitat Type of Disposal Areas
Old River Lock Tailbay	Once every 10 years	7,000	Confined on north bank of channel	160 BLHW
Three Rivers (Mile 0 Atchafalaya River)	Annually	150,000	In deep water in Atchafalaya River	
McCrea Landing (Mile 12 Atchafalaya River)	Once every 15 years	23,000	Disposed in shallow water in Atchafalaya River along either side of dredged channel	
East Freshwater Distribution Channel	Once every 10 years	160,000	Confined on bank adjacent to waterway	300 CT 670 BLHW
East and West Access Channels	Once every 10 years	610,000	Confined on bank adjacent to waterway	470 ES 1700 BLHW
Below Bayou Sorrel (Alternate Route GIWW)	Annually	170,000	Confined on bank adjacent to waterway	400 CT
Sixmile Lake	Once every 5 years	480,000	Disposed in deep water in Atchafalaya River and contained sites on north bank	2500 ES
Berwick Bay Harbor	Annually	500,000	Disposed in deep water in Atchafalaya River	
Berwick Lock Forebay	Once every 2 years	70,000	In deep water on Atchafalaya River and adjacent to river bank below the forebay	60 ES

ES = Early successional bottomland hardwood
BLHW = Mid to late successional bottomland hardwood
CT = Cypress-tupelo

(4) Types of Habitat. Discharge would occur in four habitat types, early successional bottomland hardwoods, mid to late successional bottomland hardwoods, cypress-typelo, and open water. For purposes of this evaluation, all disposal sites indicated are considered to be wetlands or waters of the US. Acreages required include 2,970 acres of early successional bottomland hardwoods, 2,530 acres of mid to late successional bottomland hardwoods, and 300 acres of cypress-tupelo.

(5) Timing and Duration of Discharge. Dredging would generally take place during low flow periods (summer and fall) and might extend from a few days to several weeks or more, depending on the site and the quantity of material to be dredged. As shown in Table G-11-24, dredging at a site might occur annually or as infrequently as once every 10-15 years.

f. Description of Disposal Method. Hydraulic dredging would be used in all instances.

II. FACTUAL DETERMINATIONS.

a. Physical Substrate Determinations.

(1) Substrate Elevation and Slope. Material placed in deep water channels would be displaced downstream as suspended sediment or bedload and would not significantly affect substrate elevation or slope. In the wetland sites, existing elevations range from about 0-2 feet NGVD to 10-40 feet NGVD. Disposal over time would raise elevations. Land-disposed materials would be well distributed to promote drainage and consolidation.

(2) Sediment Type. The dredged material would generally be similar to that in the disposal areas, with the exception that it would contain less organic material in the case of disposal in wetland habitats. Both the dredging and disposal sites would contain material of alluvial origin.

(3) Dredged/Fill Material Movement. Material placed in open water would move downstream as suspended sediment or bed load. All other material would be placed in confined disposal sites. Leaching during storm events would be expected, but dikes and weirs would be sufficiently high to prevent overflow during storms.

(4) Physical Effects on Benthos. Disposal of dredged material into relatively deep water habitats would destroy those organisms present, but these areas generally do not support diverse or abundant populations of benthos. Also, recolonization would occur rather rapidly. Of the other disposal sites, only the cypress-tupelo habitat supports resident populations of benthos. These would be destroyed by disposal. Seasonal use of the early and mid to late successional bottomland hardwood habitats would be reduced by disposal.

(5) Other Effects. Existing vegetation (300 acres cypress-tupelo, 2,530 acres mid-to-late successional bottomland hardwoods, and 2,970 acres of early successional bottomland hardwoods) in the disposal sites would be destroyed over the project life, but the areas would revegetate over time to early successional bottomland hardwoods. Kinds and numbers of animals using the disposal sites would be dependent on the successional stage of the vegetation in the areas.

(6) Actions Taken to Minimize Impacts. To the extent feasible, disposal sites have been located to avoid adverse impacts to high quality habitat. The discharge would be confined to the smallest practicable area commensurate with adequate drainage capability, and the effluent returned to channel areas to avoid unnecessary adverse impacts on adjacent wetlands or shallow water bottoms.

b. Water Circulation, Fluctuation, and Salinity Determinations.

(1) Water.

(a) Salinity. No effect.

(b) Water Chemistry. Observed data from a water quality monitoring program conducted in the Atchafalaya Floodway area downstream of Morgan City in 1975 and 1976 indicated little variation in the pH during testing. Tests were conducted at and near dredging sites and confined disposal areas, and prior to, during, and after dredging.

(c) Clarity and Color. Dredged material disposal in waterways would reduce clarity and produce visible plumes downstream from the sites. Clarity and color would return to normal soon after dredging was completed.

(d) Odor and Taste. Significant effects on water odor and taste are not expected.

(e) Dissolved Gases. During the dredging operation, dissolved-oxygen in the immediate area downstream of the open-water disposal area might fall below ambient concentrations due to oxygen demanding substances in the dredged material. However, due to the short-term nature of the work, the normally high ambient dissolved oxygen concentration, and natural turbulence of the river, this effect is expected to be of short duration and very localized. Some localized reductions in dissolved oxygen within confined disposal areas and in vicinity of effluent return would be expected.

(f) Nutrients. Macronutrients are normally high in the Atchafalaya River system. Significant effects of increasing the amount of available nutrients are not expected in the river, however, disposal areas would experience elevated levels. Elutriate tests of representative dredged materials have shown ammonia-nitrogen to be present above ambient levels. In un-ionized form, ammonia is toxic to aquatic organisms. However, in a river system such as the Atchafalaya which exhibits a nearly neutral pH, is highly buffered, and has a large dilution capacity, toxic ammonia problems are not expected to develop.

(g) Eutrophication. Acceleration of eutrophication is not expected as a result of open water disposal, however, in confined disposal areas localized eutrophication might occur.

(2) Current Patterns and Circulation. Maintenance dredging would be expected to have little effect on the river currents or circulation other than to promote more uniform conditions. Current patterns and circulation in the wetland areas designated for disposal would be eliminated. Wetland areas adjacent and landward of disposal areas would receive reduced flow.

(3) Normal Water Level Fluctuations. Maintenance dredging, by sustaining a relatively unchanging channel, would slightly moderate normal water fluctuations. Moderation would not alter average discharges, but would reduce the extremity of high and low water levels. In wetlands not altered by disposal, water levels would be moderated and be expected to decrease, however, reduced sediment and organic input due to less circulation could tend to keep water levels approximately the same.

(4) Salinity Gradients. No significant effects.

(5) Actions that will be Taken to Minimize Impacts. Dredged material would be placed into confined disposal sites. As solid materials settle, transport water would be returned to adjacent water channels through controlled spillgates constructed in the retention dikes. The effluent from these areas should not pose any significant water quality problems if retention times are sufficient. In areas located along the main channel, such as Three Rivers, McCrea Landing, and Berwick Harbor, open water disposal is considered the least environmentally damaging alternative. Open water discharge would have only minor and short-term effects, whereas land disposal would destroy valuable wildlife habitat.

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site. The lower Atchafalaya River is turbid and has a high concentration of suspended sediments. The dredged material is predominately sand with some silt, and would be placed mostly in confined areas to keep lateral movement and filling of aquatic and terrestrial habitat to a minimum. The effluent from

the confined disposal areas would be returned to the river and should not significantly increase suspended particulates or turbidity above ambient levels except in the immediate discharge area. At the dredging sites and in the open water disposal sites elevated suspended particulate and turbidity levels would occur. A turbidity plume would be visible downstream of the open water disposal sites.

(2) Effects on Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Light penetration would be reduced in the vicinity of the dredging operations and open water disposal sites. These effects would be localized and temporary.

(b) Dissolved Oxygen. Dissolved oxygen in aquatic habitats within the confined disposal sites and in the vicinity of the dredging operations and open water disposal would be reduced. Again, these effects would be localized and temporary.

(c) Toxic Metals and Organics. Table G-11-5, 16, 21, 22, and 25 through 28 show water and sediment data collected near maintenance dredging sites. Some of the laboratory analyses of water constituents were conducted at detection limits that exceeded EPA criteria, and thus are inconclusive. Data collected by EPA indicated few toxic metal problems in the Atchafalaya Basin. Elutriate tests indicated toxic levels due to dredging would be equal to or less than the concentrations found in native water. Also, since these same bottom materials are resuspended and relocated by river currents, particularly during flood periods, significant adverse effects caused by maintenance dredging in the Atchafalaya Basin Floodway System would not be expected.

(d) Pathogens. No significant effects.

(e) Esthetics. The increased turbidity caused by dredging and open water disposal would be localized and temporary. The esthetic appeal of confined disposal sites would be minimal until revegetation occurs. Fifty-eight hundred acres of wetlands would be altered by use as disposal sites.

(3) Effects on Biota.

(a) Primary Production, Photosynthesis. Primary production in large, turbid, alluvial rivers like the Atchafalaya is low, with most of the food energy coming from outside the river in the form of organic detritus. Covering about 5,800 acres of cypress-tupelo and bottomland hardwoods with dredged material over the project life would temporarily remove a significant source of organic detritus from the lower Atchafalaya ecosystem, but revegetation with early successional bottomland hardwoods would occur rapidly. The phytoplankton production in the cypress-tupelo habitats would be lost, and use of the

TABLE G-11-25

WATER AND SEDIMENT DATA
SITE NO. 7, 1975
SIXMILE LAKE

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Residue Lost on Ignit.					5,250/12,800
Residue, Suspen. 110C	144,000/284,000				
Residue, Tot. Nonfil, 105C	44,000/278,000				
Residue, Vol. Susp.	20,000/22,000				
Oil and Grease	2,000/0				1/1
Chlorides					
COD	14,000/11,000		14,000/9,000		1,900/4,600
DKN		310/250	260/410		
TKN					84/300
Cyanide	0/0		0/0	3.5	0/0
Phenols	12/17		10/8	2,600	
Calcium					
Magnesium					
Manganese					
Iron				1,000	
Mercury		0.0/0.0	0.0/0.0	0.20	0.05/0.08
Lead		1/1	0/1	3.8*	10/10
Zinc		10/0	0/0	47	17/25
Chromium		0/0	0/0	0.29	3/4
Cadmium		0/0	0/0	0.025*	1/1
Copper		4/4	2/3	5.6	2/3
Nickel		2/1	2/0	96*	5/10
Arsenic		2/0	2/1	40	0/0
2,4-D	0.02/0.04			370	
2,4,5-T	0.01/0.01				
DDD					0.0008/0.0004
DDE					0.0002/0.0001
DDT				0.0010	0.0/0.0
Dieldrin				0.0019	0.0004/0.0001
Endrin				0.0023	0.0/0.0
Silvex	0.01/0.01				

*Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.

TABLE G-11-26

WATER AND SEDIMENT DATA
SITE NO. 8, 1975
BERWICK LOCK ENTRANCE CHANNEL

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Residue Lost on Ignit.					23,400/18,000
Residue, Suspen. 110C	108,000/192,000				
Residue, Tot. Nonfil, 105C	28,000/82,000				
Residue, Vol. Susp.	20,000/18,000				
Oil and Grease	2,000/1,000				1/1
Chlorides					
COD	11,000/12,000		11,000/11,000		9,500/5,400
DKN		300/410	460/400		
TKN					330/230
Cyanide	0/0		10/0	3.5	0/0
Phenols	18/21		12/7	2,600	
Calcium					
Magnesium					
Manganese					
Iron				1,000	
Mercury		0.0/0.0	0.0/0.1	0.20	0.08/0.13
Lead		1/2	1/1	3.8*	10/10
Zinc		4/0	0/0	47	4/26
Chromium		0/0	0/0	0.29	4/5
Cadmium		0/0	0/0	0.025*	1/1
Copper		4/3	3/3	5.6	7/6
Nickel		2/2	2/1	96*	5/10
Arsenic		2/1	0/1	40	4/0
2,4-D	0.03/0.04			370	
2,4,5-T	0.01/0.01				
DDD					0.0013/0.0
DDE					0.0008/0.0
DDT				0.0010	0.0012/0.0
Dieldrin				0.0019	0.0003/0.0
Endrin				0.0023	0.0002/0.0
Silvex	0.01/0.01				

*Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.

TABLE G-11-27

WATER AND SEDIMENT DATA
SITE NO. 9, 1975
BERWICK BAY FLOODWALL

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Residue Lost on Ignit.					5,630/5,430
Residue, Suspen. 110C	120,000/132,000				
Residue, Tot. Nonfil, 105C	40,000/36,000				
Residue, Vol. Susp.	8,000/18,000				
Oil and Grease	2,000/3,000				1/1
Chlorides					
COD	12,000/11,000		11,000/15,000		1,200/1,600
DKN		290/260	300/260		
TKN					100/130
Cyanide	0/0		0/0	3.5	0/0
Phenols	12/8		9/8	2,600	
Calcium					
Magnesium					
Manganese					
Iron				1,000	
Mercury		0.0/0.0	0.0/0.0	0.20	0.05/0.05
Lead		1/0	0/0	3.8*	10/10
Zinc		10/6	0/0	47	16/17
Chromium		0/0	0/0	0.29	4/3
Cadmium		0/0	0/0	0.025*	1/1
Copper		2/4	3/2	5.6	2/1
Nickel		2/2	2/2	96*	5/5
Arsenic		1/1	1/2	40	0/0
2,4-D	0.06/0.06			370	
2,4,5-T	0.01/0.01				
DDD					0.0002/0.0003
DDE					0.0/0.0
DDT				0.0010	0.0002/0.0
Dieldrin				0.0019	0.0003/0.0001
Endrin				0.0023	0.0/0.0
Silvex	0.01/0.01				

*Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.

TABLE G-11-28

WATER AND SEDIMENT DATA
SITE NO. 11B, 1981 SAMPLING
FLOODSIDE BORROW PIT IN TOWN OF BAYOU PIGEON

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Total Solids, % by Wgt					50.1
Total Volatile Solids					1.65
Turbidity	30,000				
Suspended Solids	51,800				
Volatile Suspended Solids	21,600				
Oil and Grease					174
Chlorides	30,000				
COD	11,000	11,000	23,000		75,500
TKN	870		860		792
Cyanide	< 10		< 10	3.5	
Phenols	< 10		< 10	2,600	
Nitrite-N	31		67		< 0.20
Nitrate-N	1,430		1,360		< 0.20
Total Nitrogen-N	2,330		2,290		792
Ammonia-N	50		235	20**	17.0
OrthoPhosphate-P	69	23	< 10		1.96
Total Phosphorus-P	170	< 100	< 100		656
Calcium	40,300	39,600	36,700		
Magnesium	11,500	11,400	12,500		
Manganese	101	23	519		440
Iron	2,130	46	< 25	1,000	33,000
Mercury	< 0.2	< 0.2	< 0.2	0.20	< 0.10
Lead	3	< 1	< 1	3.8*	19.3
Zinc	< 25	< 25	< 25	47	95.9
Chromium	2	< 1	< 1	0.29	32.7
Cadmium	0.4	0.2	0.1	0.025*	0.27
Copper	5	3	5	5.6	27.8
Nickel	< 1	< 1	< 1	96*	38.7
Arsenic	1	< 1	1	40	6.72

* Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.
**Criterion is for un-ionized ammonia, which would comprise about 1 percent of total ammonia at anticipated pH and temperature conditions.

disposal areas by planktonic organisms during high water would be reduced. Significant effects on photosynthesis would not occur.

(b) Suspension/Filter Feeders. Riverine and distributary habitats in the Atchafalaya Basin generally support sparse benthic populations compared to other aquatic habitats. For example, the mean number of benthic organisms per square meter in riverine areas was found to be 327, as compared to 1,840 in headwater lakes, 3,292 in bayous, and 3,768 in swamps. Tubificid worms, chironomids, burrowing mayflies, damselfly nymphs, and Asiatic clams are commonly found in riverine habitats. Initially, these organisms would be lost at the dredging sites, but recolonization would occur. In disposal sites, the loss of cypress-tupelo habitat (which supports the largest number of benthic organisms) would result in the reduction of populations of amphipods, clams, dipteran larvae, snails, isopods, and mayflies. These areas would be flooded only during high-flow events.

(c) Sight Feeders. No appreciable effects on sight feeders would be expected in the vicinity of dredging operations. About 300 acres of cypress-tupelo swamps, which support sight feeders such as largemouth bass, bowfin, shad, warmouth, and crappie, would be lost. Use of other terrestrial habitats in the disposal areas by sight feeders during moderate to low flows would be reduced.

(4) Actions Taken to Minimize Impacts. See sections II.a.(6) and II.b.(5).

d. Contaminant Determinations. The material proposed for discharge are similar to that in the disposal sites, and contaminant levels would be expected to be low. The proposed discharge would not be expected to introduce, relocate, or significantly increase contaminants.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton. Plankton populations in the Atchafalaya River and distributaries consist mainly of diatoms, desmids, cladocerans and copepods. No significant effects would occur in the main channel. Plankton populations in disposal areas, primarily confined to the cypress-tupelo habitats, would be lost.

(2) Effects on Benthos. See Section II.c.(3)(b).

(3) Effects on Nekton. No significant effects in main channel. Fish populations in cypress-tupelo habitat in disposal reas would be lost and use of other habitats in disposal areas by fishes would be reduced.

(4) Effects on Aquatic Food Web. Loss of about 5,800 acres of vegetated aquatic and terrestrial habitat over the project life would reduce detrital material available for processing and use in the aquatic food web.

(5) Special Aquatic Site Effects-Wetlands. As noted earlier, for purposes of this evaluation, all habitats found in the proposed disposal areas (cypress-tupelo, mid to late successional bottomland hardwoods, and early successional bottomland hardwoods) are considered wetlands. The proposed discharge would destroy existing vegetation and plant succession would begin within a year. If not modified by subsequent dredging and disposal, these areas (or portions of them) would succeed into early successional bottomland hardwood. Future disposal would reinitiate the process. Wetland values of the disposal sites would be reduced due to less frequent flooding.

(6) Threatened and Endangered Species. No significant effects. See Appendix H and EIS for detailed discussion.

(7) Other Wildlife. The proposed discharge would result in the loss of about 5,800 acres of wildlife habitat over the project life, including 300 acres of cypress-tupelo, 2,530 acres of mid to late successional bottomland hardwoods and 2,970 acres of early successional bottomland hardwoods. The mid to late successional bottomland hardwoods provide the best wildlife habitat in the basin, with an abundance of soft and hard mast producing trees, a diverse woody understory, and abundant herbaceous groundcover. This is the best habitat type in the basin for white-tailed deer, squirrels, non-game mammals, and some furbearers. Bird species diversity and numbers per unit area are highest in this habitat. Early successional bottomland hardwoods of the type found in the proposed discharge sites (primarily young, dense stands of willow) do not represent a quality habitat for most species of wildlife, but are heavily used by certain seasonally abundant species such as the yellow-rumped warbler or by white-tailed deer when basin water levels are low. The lack of mast and browse probably accounts for the low carrying capacity and species diversity. The cypress-tupelo swamp habitats are primarily favorable for wildlife species that are water-oriented at some stage of their life cycle. They are less productive overall than the more mature bottomland hardwoods, but more productive than the early successional bottomland hardwoods. Deer and squirrels are not abundant, but these areas are heavily used by beaver, nutria, mink, and raccoon. Cypress-tupelo is the preferred habitat for many species of herons, egrets, ibises, flycatchers, and warblers, and serves as an important breeding and production area for wood ducks.

(8) Actions to Minimize Impacts. See sections II.a.(6) and II.b.(5).

f. Proposed Disposal Site Determinations.

(1) Mixing Zone Determination. Mixing zones for open water disposal for suspended sediment were calculated using average annual values of river flow and suspended sediment concentrations at Simmesport and Morgan City. Results are summarized in Table G-11-29. The mixing zone required to dissipate the discharge of hydraulically dredged material to a level of 1.25 times the average ambient concentration of suspended sediment requires a maximum of 19.8 water surface acres in the Sixmile/Grand Lake area to a minimum of 1.7 water surface acres in the Lower Atchafalaya River. These river mixing zone areas are not considered ecologically significant. Mixing zones for confined disposal areas were not calculated. Effluents from these areas would discharge into the main river channels. Any water quality effects would be very localized and occur in the immediate vicinity of the return flows.

TABLE G-11-29

MIXING ZONE CHARACTERISTICS, MAINTENANCE DREDGING

Parameter	Upper Atchafalaya River*	Lower Atchafalaya River+	Grand/Six Mile Lake+
Ambient Suspended Sediment (mg/1)	296	246	246
1.25 x Suspended Sediment (mg/1)	370	307	307
Flow Required to Dilute Discharge to 1.25 Suspended Sediment Concentration (cfs)	6,119	7,470	7,470
Width of Front Edge of Mixing Zone (ft)	113	73	234
Length of Mixing Zone (ft)	1,935	1,472	6,548
Total Affected Water Surface Acres (acres)	3.2	1.7	19.8
Time of Transport Through Mixing Zone (minutes)	11.0	12.3	54.6

* Based on Data at Simmesport, La.
\+ Based on Data at Morgan City, La.

(a) Depth of Water at Disposal Site. Depths of water and/or location of the discharge, where appropriate, are shown in Table G-11-30. Open water disposal operations would discharge effluents to water with depths ranging from a minimum of 8-12 feet below the LWRP to a maximum of 42-50 feet below the LWRP. Depths of water for return flow from confined areas would range from less than one foot to generally not greater than three feet.

TABLE G-11-30

DEPTH/LOCATION OF MAINTENANCE DREDGING DISPOSAL SITES

Location	Spoil Area	Depth/Location
Three Rivers (Mile 0 Atchafalaya River)	Open Water	12-25 feet below LWRP.
McCrea Landing (Mile 12 Atchafalaya River)	Open Water	8-12 feet below LWRP.
Grand and Sixmile Lake	Open Water	12-20 feet below LWRP.
Berwick Bay Harbor and Berwick Lock Forebay.	Open Water	42-50 feet below LWRP.

(b) Current Velocity, Direction, and Variability at the Disposal Site. Current velocities for main channel disposal would range from one to five feet per second. Flow direction is downstream. Current velocities in confined disposal areas would be generated by inflowing spoil and would quickly diminish with dispersal in the disposal areas.

(c) Degree of Turbulence. The lower Atchafalaya River is naturally turbulent. Disposal in the open river might increase turbulence in the general vicinity of the effluent pipe. Localized turbulence in confined disposal areas would be generated by the disposal operation.

(d) Stratification. Not applicable.

(e) Rate of Discharge. Rates of discharge would generally range from 500-1,000 cubic yards of dredged material per hour.

(f) Ambient Concentration of Constituents of Interest. Elutriate analyses of representative samples at maintenance dredging sites were made in 1975 and 1981. Tables G-11-5, 16, and 28 show native water, elutriate and sediment data in the Atchafalaya River above Morgan City, the West Access Channel, and the GIWW Alternate Route south of Bayou Sorrel, respectively. Analyses of samples from maintenance dredging sites in the vicinity of Morgan City in the Lower Atchafalaya River were also analyzed, and are given in Tables G-11-21, G-11-22, and G-11-25 through G-11-27. The sampling locations are shown on Plates G-18, and G-27. No heavy metal concentrations were found to increase consistently over ambient water levels. Cadmium, chromium and cyanide were unmeasurable at current (Dec 1980) EPA criteria levels, so their release potentials could not be conclusively determined. On the basis of these data and the expected high dilution capacities of the waters, mixing zone calculations were not considered necessary. During the disposal operations, suspended sediment concentrations would be much higher than the ambient levels. Sediments would also be carriers of heavy metals and pesticides and might provide an indication of potential movement or relocation of pollutants. Suspended sediment concentrations vary from average annual low of 246 mg/l at Morgan City to an average high of 417 mg/l for the water years 1965-1971. Of these concentrations, 7.5 percent were sands and 92.5 percent were silts. The average total sediment load for this period was 46 million tons. Annual suspended sediment loads at Simmesport average 108 million tons, with approximately 23 percent sands and 77 percent silts. Average annual suspended sediment concentration was 550 mg/l.

(g) Dredged Material Characteristics. Dredged materials would vary with specific location, but characteristically are mainly sands with some silt along the main channel and outlets, and are primarily silt and clay with some sand along the distributaries and the GIWW Alternate Route. The representative dredged material sample sites indicate a range of 3 percent to 97 percent sands. Total average annual amounts of dredged material for dredging sites are shown in Table G-11-24 and total 2,170,000 cubic yards. Of this total, approximately 1,400,000 cubic yards would be placed in confined spoil areas and 700,000 cubic yards would be disposed of in the Atchafalaya River channel. Settling within the confined disposal areas would be rapid for sands, however, significant portions of silts and clays would re-enter the main channel in the effluent. Spoil placed in the main channel would tend to remain in suspension, with sand settling out at some distance below the discharge and silts remaining in suspension.

(h) Number of Discharge Actions Per Unit of Time. Dredging would occur primarily during the summer and fall months (moderate to low flow conditions) and would extend over the project life. The rate of discharge would depend on the size of dredge and operating conditions, but would be in the general range of 500-1,000 cubic yards of dredged material per hour.

(2) Determination of Compliance with Applicable Water Quality Standards. The Louisiana State Water Quality Criteria for the Atchafalaya River are indicated in Table G-11-6. The general criteria

dealing with esthetics, color, floating, suspended and settleable solids, taste and odor, toxic substances, oil and grease, foaming or frothing material, nutrients, and turbidity are also applicable. The only category of toxic substances determined to be applicable to dredged material pursuant to Section 307 of the Clean Water Act of 1977 is polychlorinated biphenyls. This class of chemicals was not detected at the Atchafalaya River representative sampling sites in 1981, although, analysis of bottom sediments during 1975 in the lower river indicated PCB's do occur in the project area. Chemical analyses of samples from open water dredge disposal sites did not detect mobilization of the PCB's into the water column. PCB's are not expected to create water or sediment quality problems on the lower Atchafalaya River. Based on the available ambient water quality data, elutriate analyses, generally sandy composition of open water disposed materials, limited extent of mixing zones, and the short duration of the construction work period at any particular site, applicable water quality standards would not be exceeded outside the estimated mixing zones nor would any ephemeral increases in water column chemical constituents associated with dredging in the Atchafalaya River be ecologically significant. The bioavailability of toxic substances in effluents from containment areas cannot be accurately estimated from water, sediment and elutriate analyses. Those areas that would receive material primarily composed of silt and clay should be controlled such that their effluent releases would be comparable in turbidity to the receiving water body.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supply. No effects.

(b) Recreational and Commercial Fisheries. See section II.c.(3). The loss of about 5,800 acres of aquatic and seasonally flooded terrestrial habitat over the project life would adversely affect recreational and commercial fisheries to an unknown degree. The disposal areas would revegetate and furnish organic detritus to the aquatic food web, however, they would be flooded less frequently than at present. These areas could be used by aquatic and semi-aquatic animals during high water periods. Overall effects, considering the type and quantity of aquatic habitat in the basin and the rapidly changing (from aquatic to terrestrial) character of the areas proposed for disposal sites, are not significant.

(c) Water Related Recreation. No significant effects.

(d) Esthetics. Disposal areas would be unsightly until revegetation occurs. Loss of some 300 acres of esthetically-pleasing cypress-tupelo habitat would occur. Turbidity plumes would be visible downstream of dredging and open water disposal sites.

(e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. No effects.

g. Determination of Cumulative Effects on the Aquatic Ecosystem. The proposed maintenance dredging is part of an overall comprehensive plan for the Atchafalaya Basin Floodway System. The plan would accomplish flood control and navigation objectives, which are highly important in the Lower Mississippi Valley, and provide for preservation and enhancement of the very significant fish, wildlife, and other natural resources of the basin. Overall, then, the plan would result in preservation and enhancement of significant portions of the basin's aquatic environment. The plan cannot, however, prevent large-scale changes in habitat, from aquatic to terrestrial, as the maturation of the Atchafalaya River continues. The direct effects of the disposal will result in the loss or modification of 300 acres of cypress-tupelo, 2,530 acres of mid-to-late successional bottomland hardwoods, and 2,970 acres of early successional bottomland hardwoods over the project life. This compares to 451,000, 332,000, and about 100,000 acres, respectively, of these habitat types within the project-affected area (Table 6-7, page EIS-157, Vol. 1). On a percentage basis, construction of the entire project would cause a loss of 1.3, 2.7 and 6.0 percent respectively, of these habitat types. Other disposals of dredged or fill material as part of the overall plan for the Atchafalaya Basin Floodway System would add to the cumulative loss of habitat, but total loss and/or conversion of this amount of habitat is considered acceptable in the overall public interest.

h. Determinations of Secondary Effects on the Aquatic Ecosystem. The loss and/or alteration of 5,800 acres of vegetated wetland habitat would result in a reduction of organic detritus available to the aquatic ecosystem.

III. FINDING OF COMPLIANCE FOR MAINTENANCE DREDGING.

a. No significant adaptations of the guidelines were made relative to this evaluation.

b. There are no practicable alternative sites which would accomplish the objectives of the maintenance dredging and have less adverse impact on the aquatic ecosystem. The sizes of sites would be kept to the minimum, consistent with storage required for adequate settlement of solids, and effluent from the confined sites would be directed to adjacent channels where effects on the aquatic ecosystem would be minimal.

c. Use of the disposal sites would not be expected to violate state water quality standards to a significant degree. There may be some associated increases in turbidity and decreases in dissolved oxygen, but these would be localized and temporary.

d. Discharges would comply with applicable toxic effluent standards and prohibitions under Section 307 of the Clean Water Act.

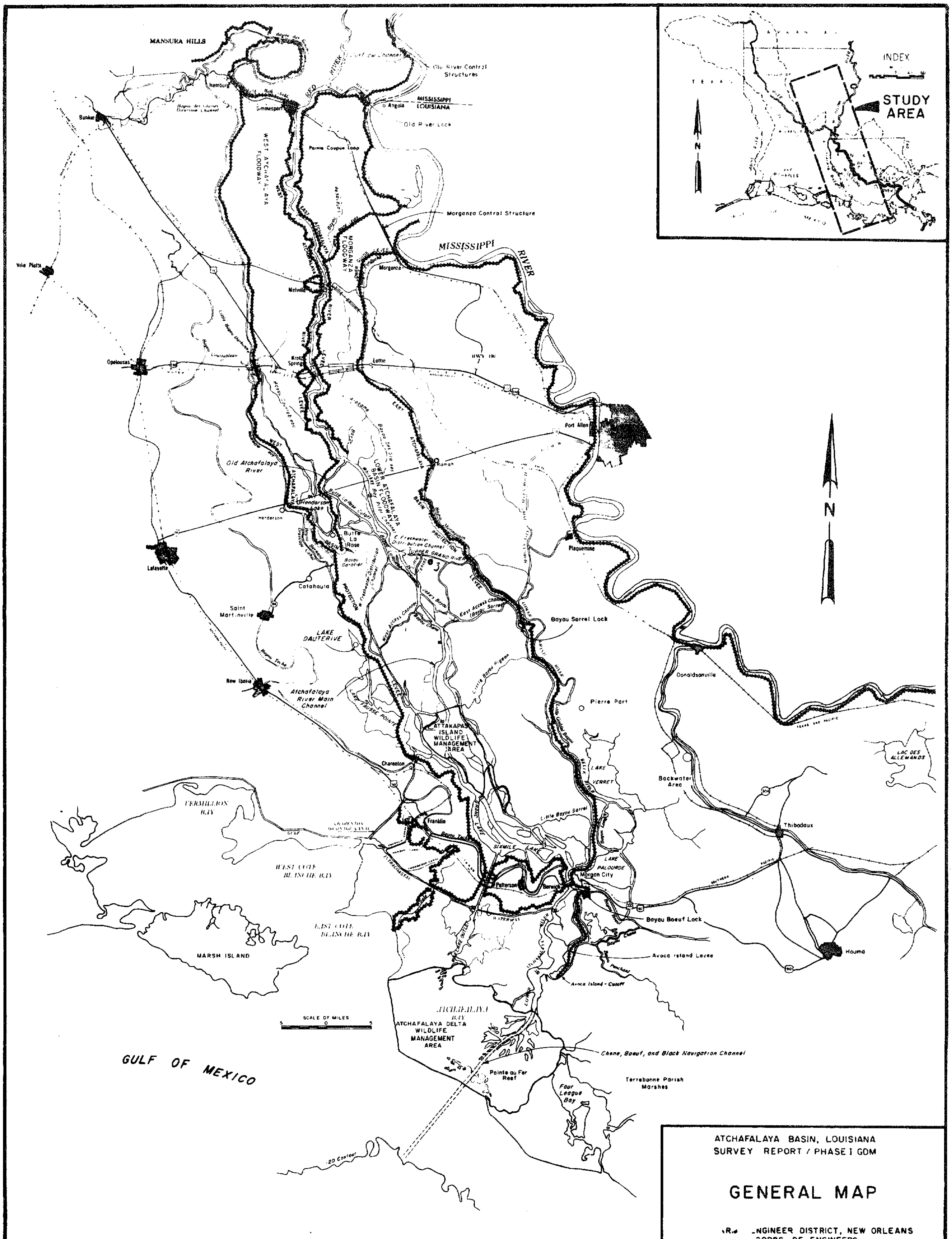
e. The proposed discharges would not jeopardize the continued existence of any threatened or endangered species or result in the destruction or adverse modification of critical habitat.

f. There are no marine sanctuaries affected by this project feature.

g. The proposed discharges would not result in unacceptable adverse effects on human health and welfare including municipal and private water supplies, recreation and commercial fisheries, plankton, fish, shellfish, wildlife, or special aquatic sites. The discharges would likewise not result in unacceptable adverse effects on life stages of aquatic or semi-aquatic organisms, aquatic ecosystem diversity, productivity, and stability, or recreational, esthetic, and economic values.

h. Confined disposal sites would be confined to the smallest practicable area and effluents returned to river channels.

i. On the basis of the guidelines the proposed disposal sites for the discharge of dredged material are specified as complying with the requirements of the guidelines with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the affected aquatic ecosystems.



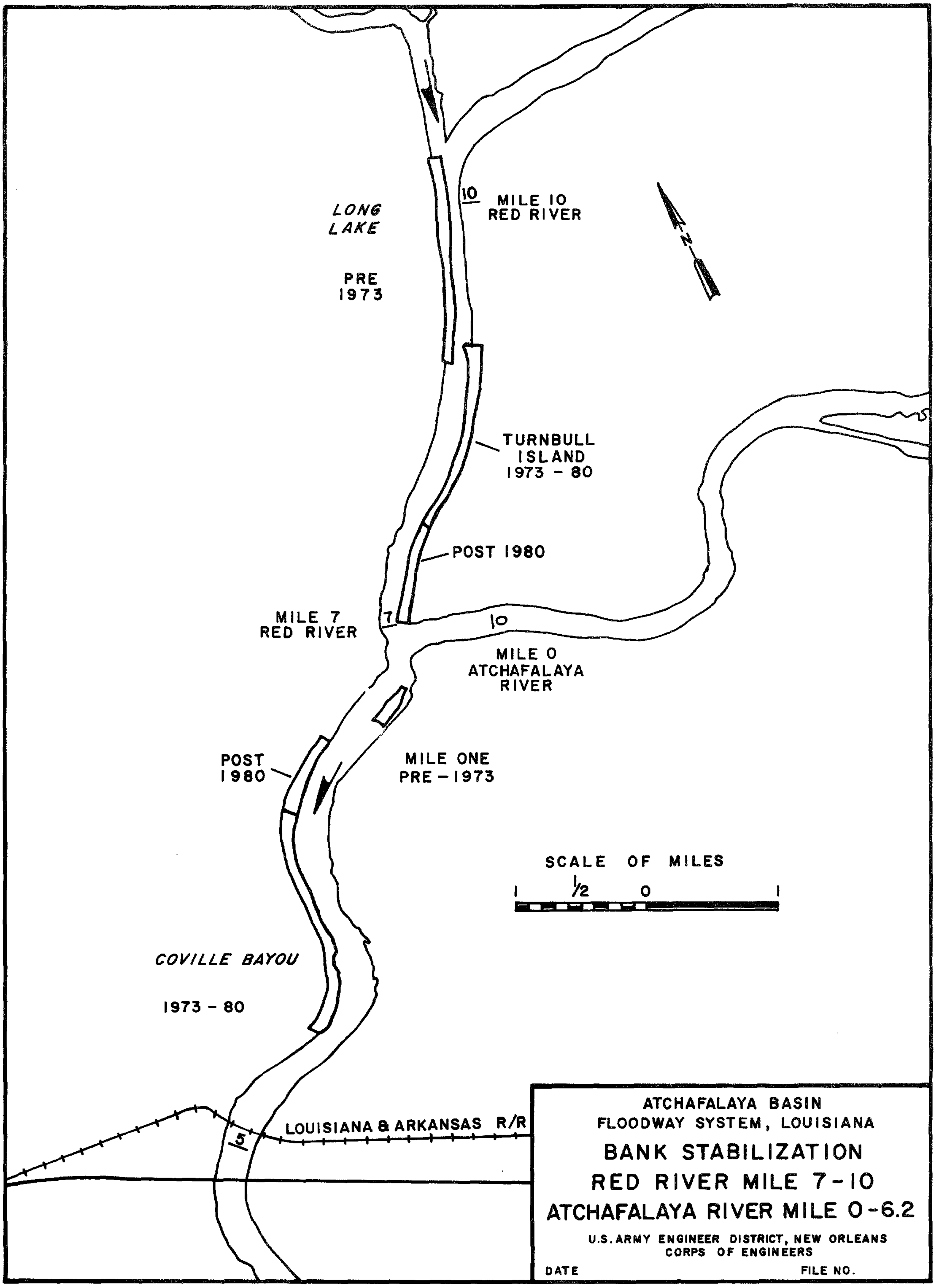
ATCHAFALAYA BASIN, LOUISIANA
SURVEY REPORT / PHASE I GDM

GENERAL MAP

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE G-1

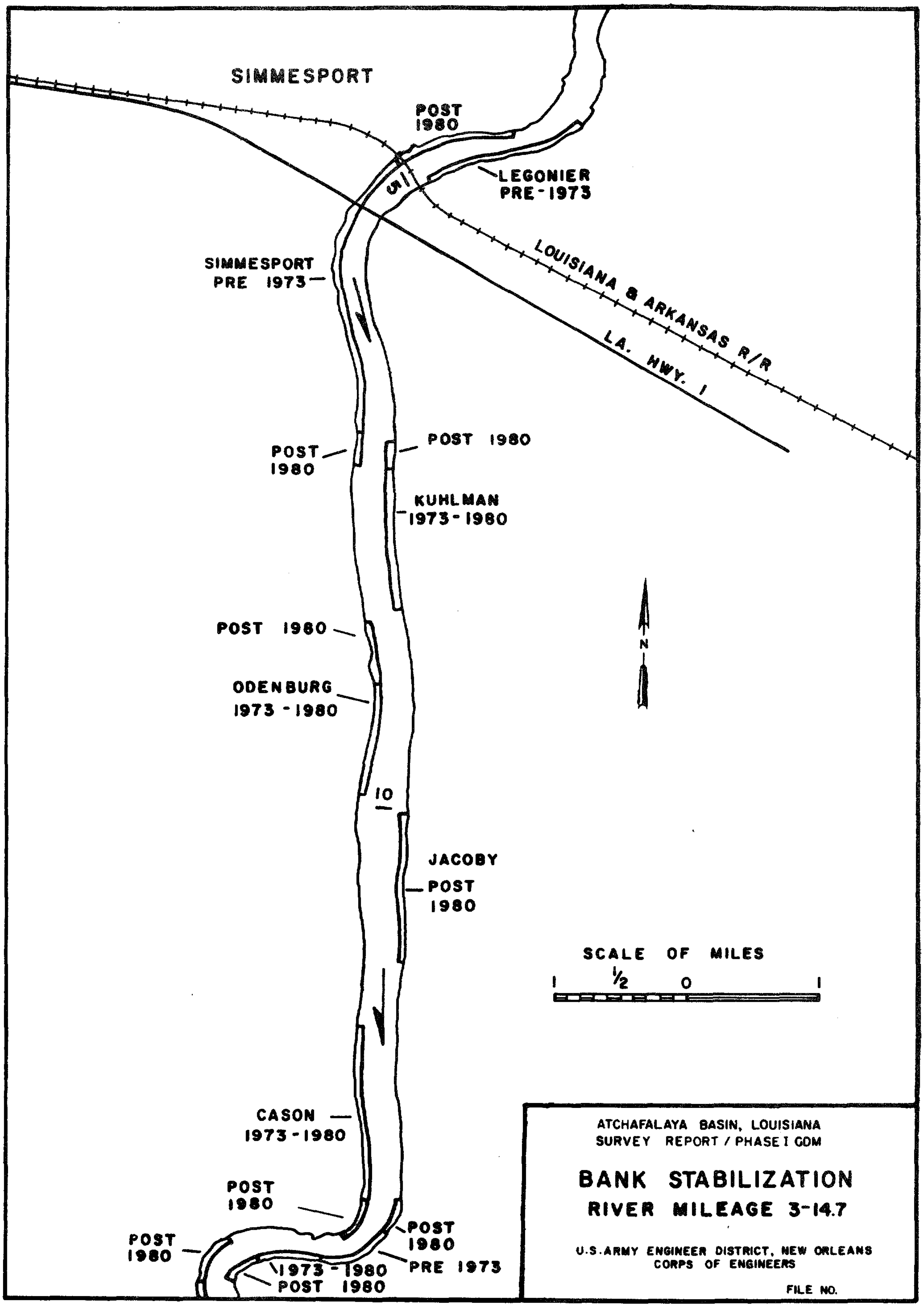


ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

BANK STABILIZATION
RED RIVER MILE 7 - 10
ATCHAFALAYA RIVER MILE 0 - 6.2

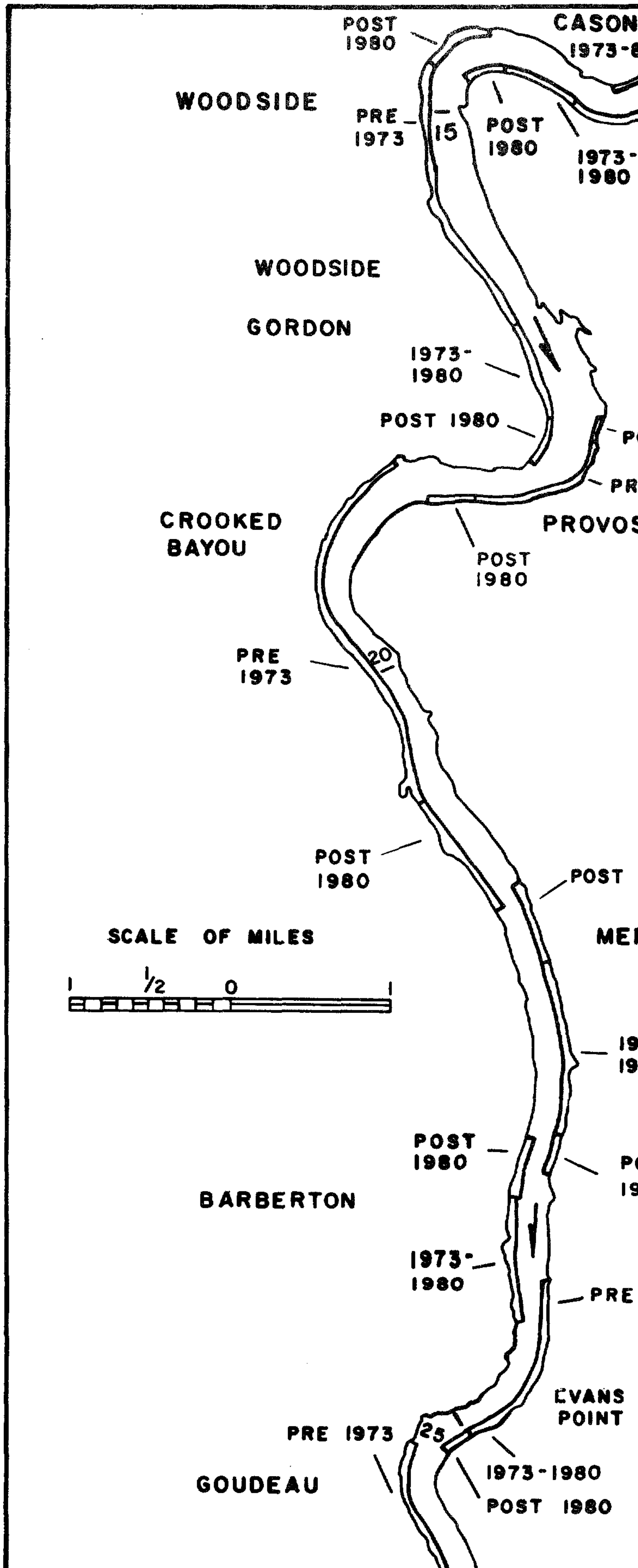
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.



SIMMESPORT
POST 1980
LEGONIER PRE-1973
5
SIMMESPORT PRE 1973
LOUISIANA & ARKANSAS R/R
LA. HWY. 1
POST 1980
POST 1980
KUHLMAN 1973-1980
N
POST 1980
ODENBURG 1973-1980
10
JACOBY POST 1980
SCALE OF MILES
1 1/2 0 1
CASON 1973-1980
POST 1980
POST 1980
POST 1980
PRE 1973
1973-1980
POST 1980
ATCHAFALAYA BASIN, LOUISIANA
SURVEY REPORT / PHASE I GDM
BANK STABILIZATION
RIVER MILEAGE 3-14.7
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE G-3



ATCHAFALAYA BASIN, LOUISIANA
SURVEY REPORT / PHASE I GDM

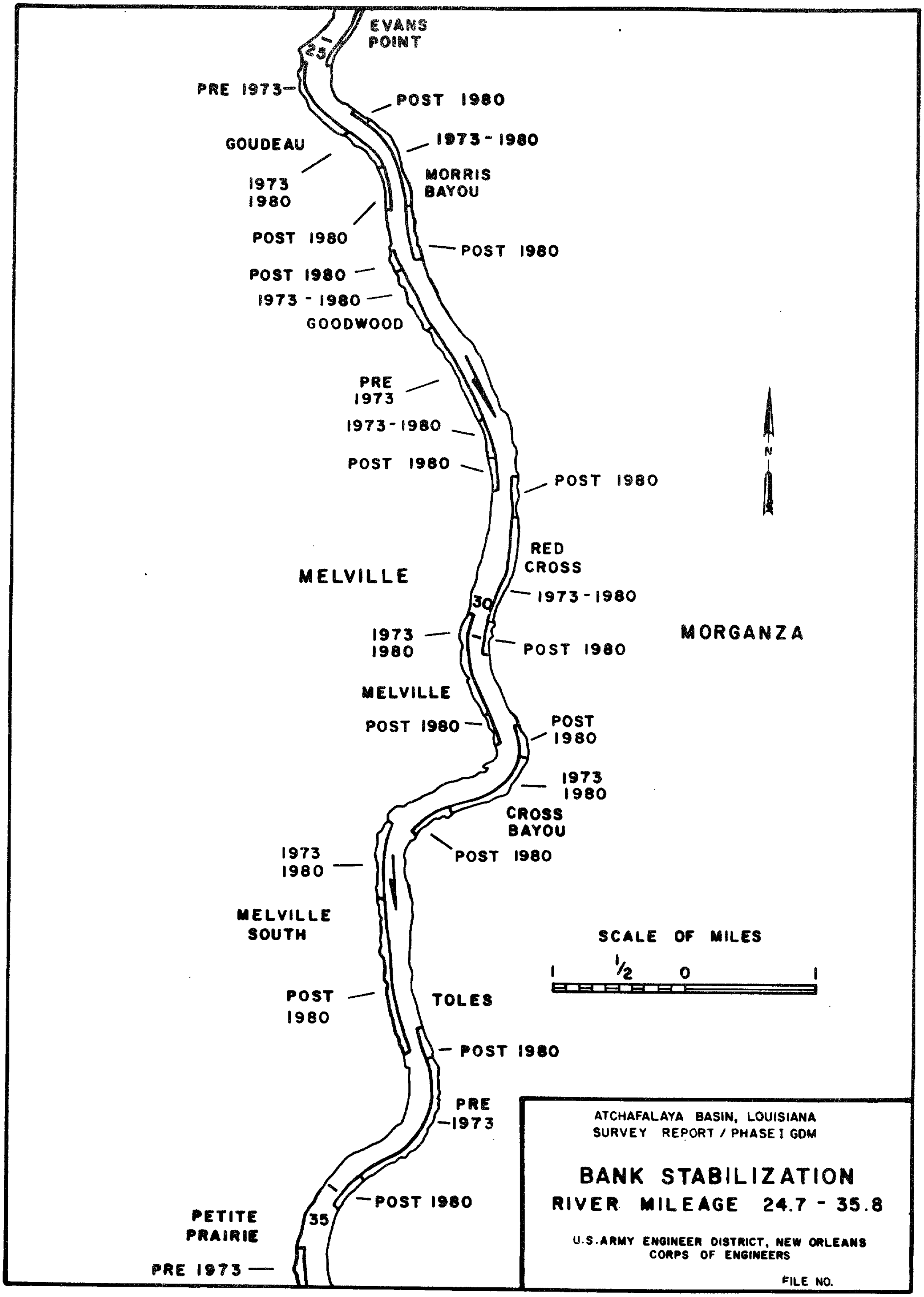
BANK STABILIZATION

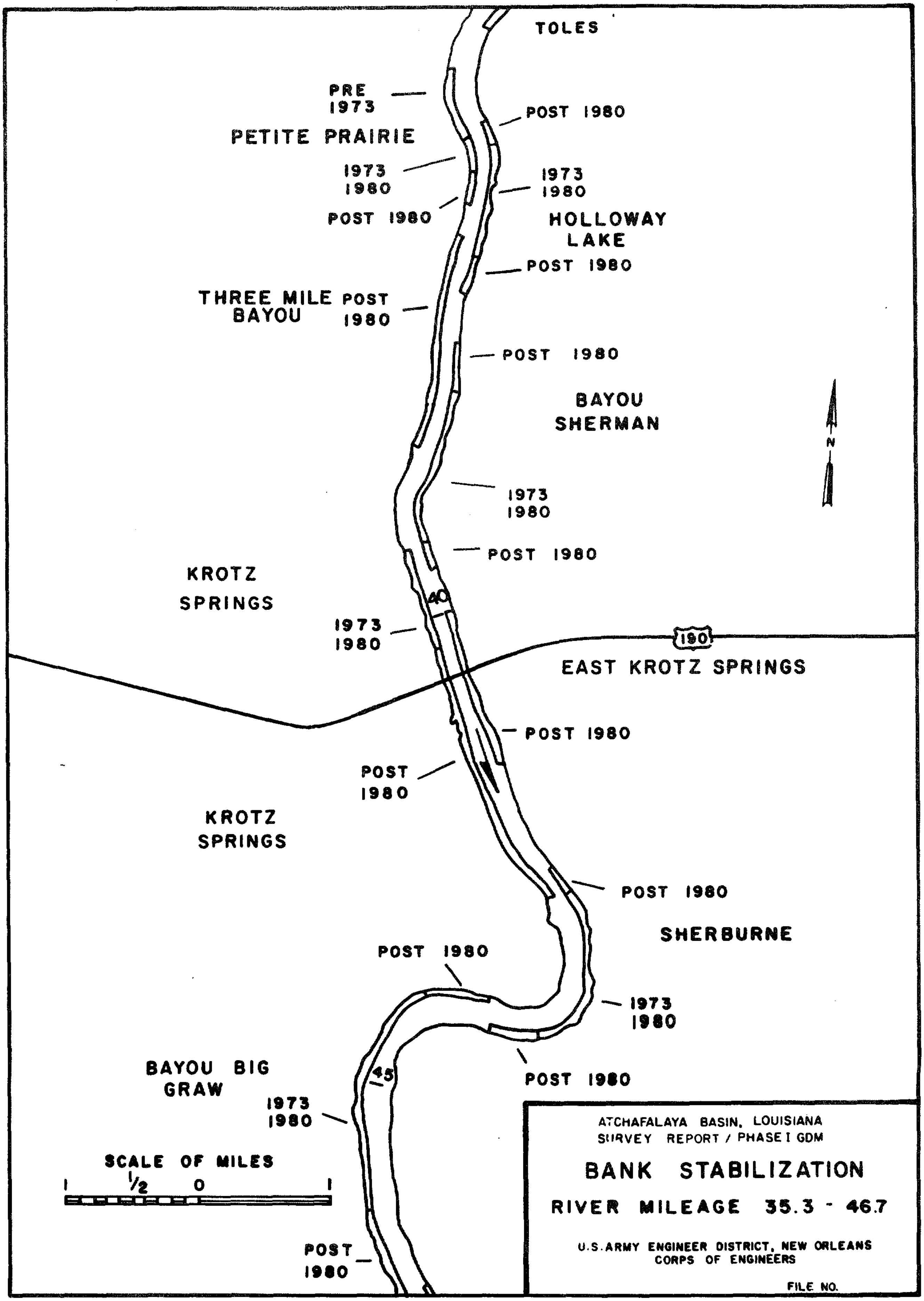
RIVER MILEAGE 12.6 - 26.1

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

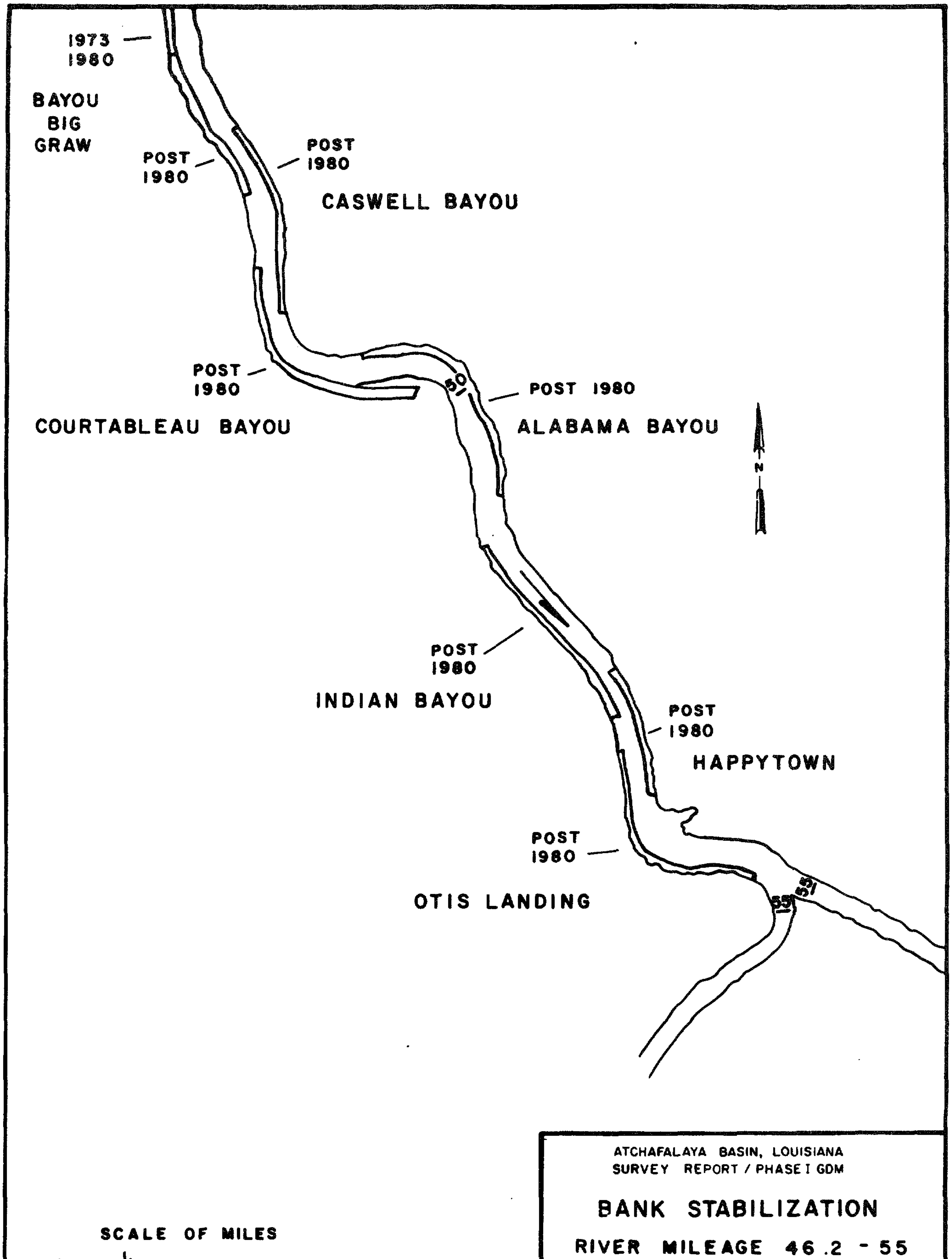
PLATE G-4


EVANS
POINT
25
PRE 1973
POST 1980
GOUDEAU
1973 - 1980
1973
1980
MORRIS
BAYOU
POST 1980
POST 1980
POST 1980
1973 - 1980
GOODWOOD
PRE
1973
1973-1980
POST 1980
POST 1980
RED
CROSS
MELVILLE
1973 - 1980
30
MORGANZA
1973
1980
POST 1980
MELVILLE
POST 1980
POST
1980
1973
1980
CROSS
BAYOU
POST 1980
1973
1980
MELVILLE
SOUTH
SCALE OF MILES
1 ½ 0 1
POST
1980
TOLES
POST 1980
PRE
1973
POST 1980
PETITE
PRAIRIE
35
PRE 1973
N
ATCHAFALAYA BASIN, LOUISIANA
SURVEY REPORT / PHASE I GDM
BANK STABILIZATION
RIVER MILEAGE 24.7 - 35.8
U.S.ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.



TOLES
PRE
1973
PETITE PRAIRIE
POST 1980
1973
1980
1973
1980
POST 1980
HOLLOWAY
LAKE
POST 1980
THREE MILE
BAYOU
POST
1980
POST 1980
BAYOU
SHERMAN
N
1973
1980
POST 1980
KROTZ
SPRINGS
40
1973
1980
190
EAST KROTZ SPRINGS
POST 1980
POST
1980
KROTZ
SPRINGS
POST 1980
SHERBURNE
POST 1980
1973
1980
POST 1980
BAYOU BIG
GRAW
45
1973
1980
SCALE OF MILES
1 1/2 0 1
POST
1980
ATCHAFALAYA BASIN, LOUISIANA
SURVEY REPORT / PHASE I GDM
BANK STABILIZATION
RIVER MILEAGE 35.3 - 46.7
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE G-6



ATCHAFALAYA BASIN, LOUISIANA
SURVEY REPORT / PHASE I GDM

BANK STABILIZATION

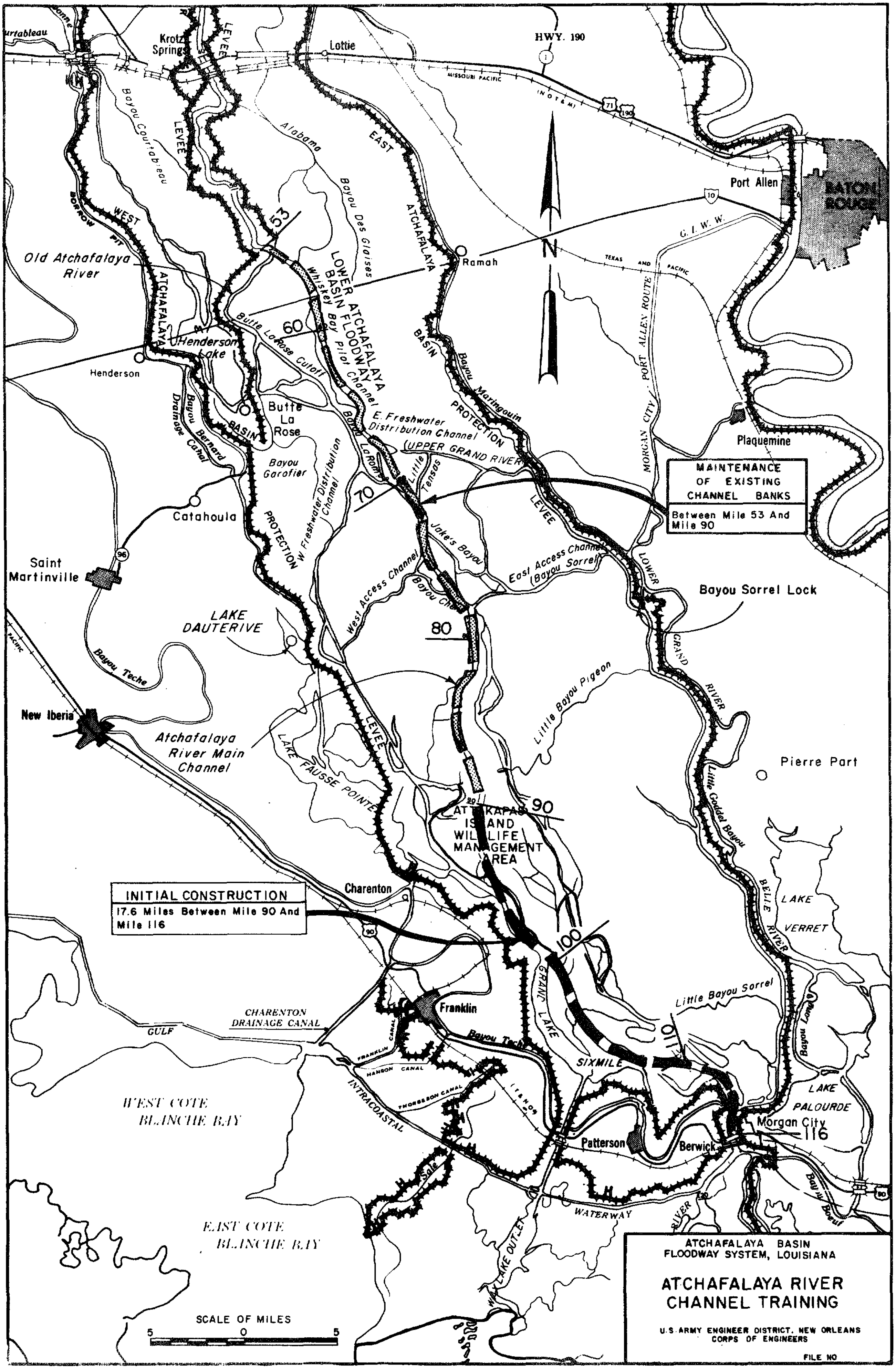
RIVER MILEAGE 46.2 - 55

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

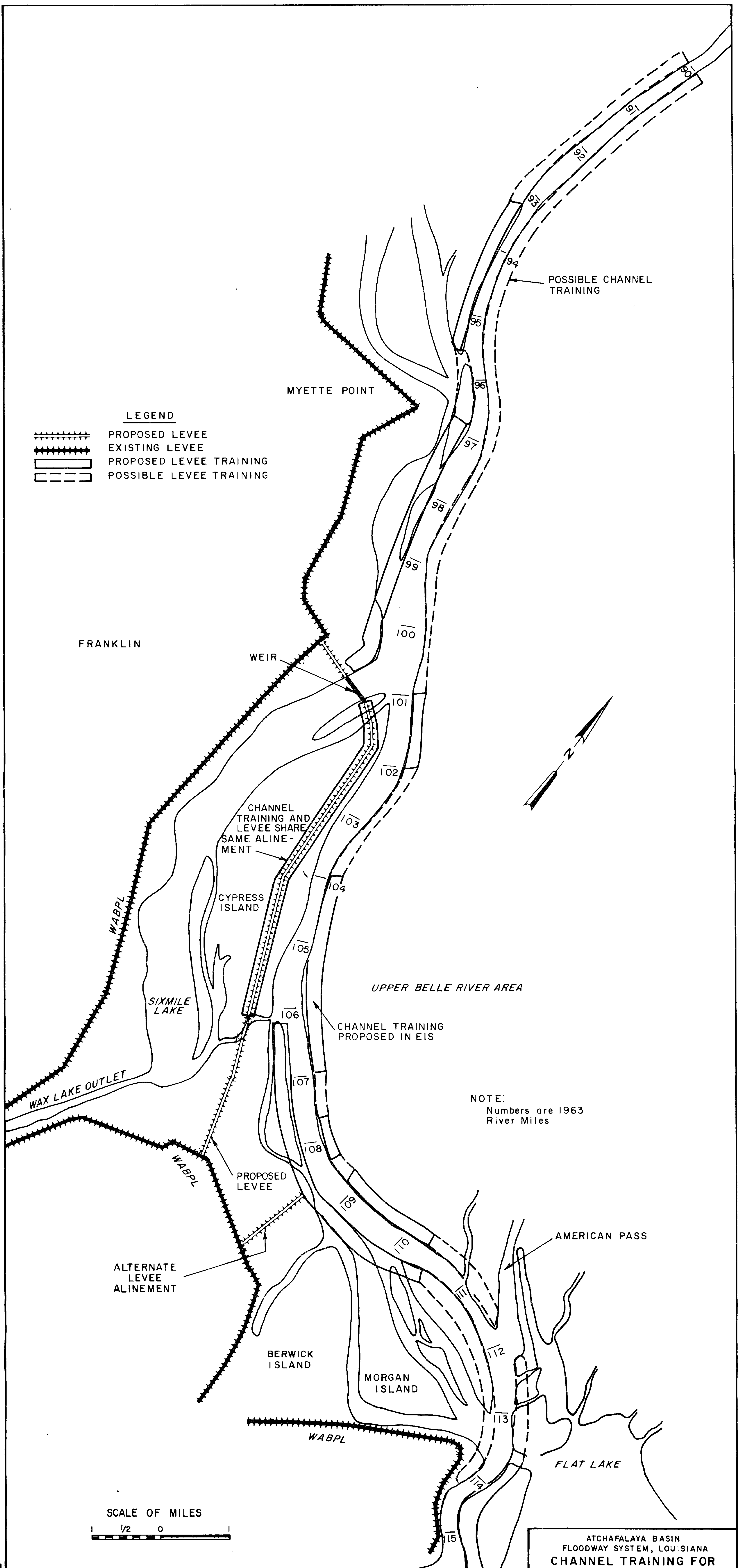
FILE NO


MISSISSIPPI
RIVER
OLD RIVER
RED RIVER
Morganza
Mc Knealy
Simmesport
Melville
ATCHAFALAYA
RIVER
Palmetto
Courtableau
EAST ATCHAFALAYA BASIN PROTECTION LEVEE
Ramah
Bayou Sorrel Lock
ATCHAFALAYA BASIN MAIN CHANNEL
Butte La Rose
WEST ATCHAFALAYA BASIN PROTECTION LEVEE
Charenton
Franklin
Bayou Boeuf
Morgan City
LOWER ATCHAFALAYA RIVER
Sta. 680+00
ATCHAFALAYA BAY
EAST COTE BLANCHE BAY
LEGEND
RECENT
Marsh deposit
Backswamp deposit
Deltaic deposit average 15' overlying backswamp clays
Natural levee deposit
Point bar deposit
Abandoned channel fill deposit
PLEISTOCENE
Levee
Lock
Drainage structure
Floodgate
Pumping station
A-Franklin Canal Levees
B-Hanson Canal Levees
C-Thorgeson Canal Levees
D-West Bayou Sale Levees
E-East Bayou Sale Levee
F-Wax Lake West Levees
G-Wax Lake Outlet West Levee
H-Wax Lake Outlet East Levee
I-Wax Lake East Levee
J-Avoca Island Levee
K-Tiger Island Levee
NOTE:
Lakes and small streams not shown. Levees in the northern part of the basin, other than floodway protection levees are not shown.
SCALE OF MILES
SCALE IN FEET
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
ATCHAFALAYA BASIN
SURFACE GEOLOGY
U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE G-8

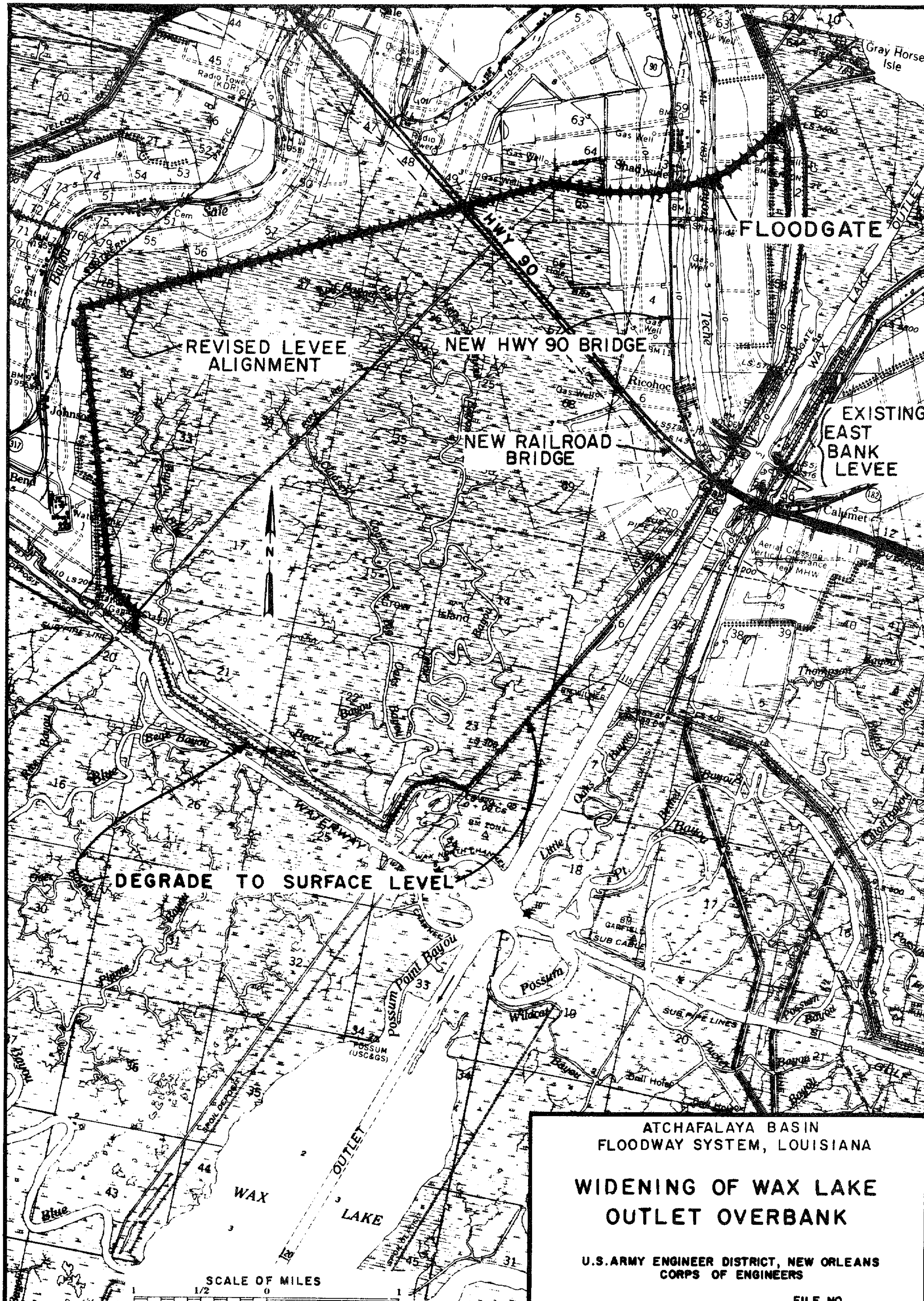


HWY. 190
Krotz Springs
Lottie
Port Allen
BATON ROUGE
Old Atchafalaya River
LOWER ATCHAFALAYA BASIN FLOODWAY
Whiskey Bay Pilot Channel
Ramah
Henderson
Henderson Lake
Butte La Rose
Catahoula
Saint Martinville
LAKE DAUTERIVE
New Iberia
Atchafalaya River Main Channel
Plaquemine
MAINTENANCE OF EXISTING CHANNEL BANKS
Between Mile 53 And Mile 90
Bayou Sorrel Lock
Pierre Part
ATTAKAPAS ISLAND WILDLIFE MANAGEMENT AREA
INITIAL CONSTRUCTION
17.6 Miles Between Mile 90 And Mile 116
Charenton
Franklin
CHARENTON DRAINAGE CANAL
WEST COTE BLANCHE BAY
EAST COTE BLANCHE BAY
Patterson
Berwick
Morgan City
LAKE PALOURDE
LAKE VERRET
SCALE OF MILES
ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA
ATCHAFALAYA RIVER CHANNEL TRAINING
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS
FILE NO



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
CHANNEL TRAINING FOR ATCHAFALAYA RIVER AND OUTLET FLOW DISTRIBUTION WORKS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE FILE NO.

PLATE G-10


REVISED LEVEE ALIGNMENT
NEW HWY 90 BRIDGE
FLOODGATE
HWY 90
NEW RAILROAD BRIDGE
EXISTING EAST BANK LEVEE
DEGRADE TO SURFACE LEVEL
N
SCALE OF MILES
WAX LAKE OUTLET
Gray Horse Isle
Ricohoc
Calumet
Possum Point Bayou
Johnson
Teche
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
WIDENING OF WAX LAKE
OUTLET OVERBANK
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

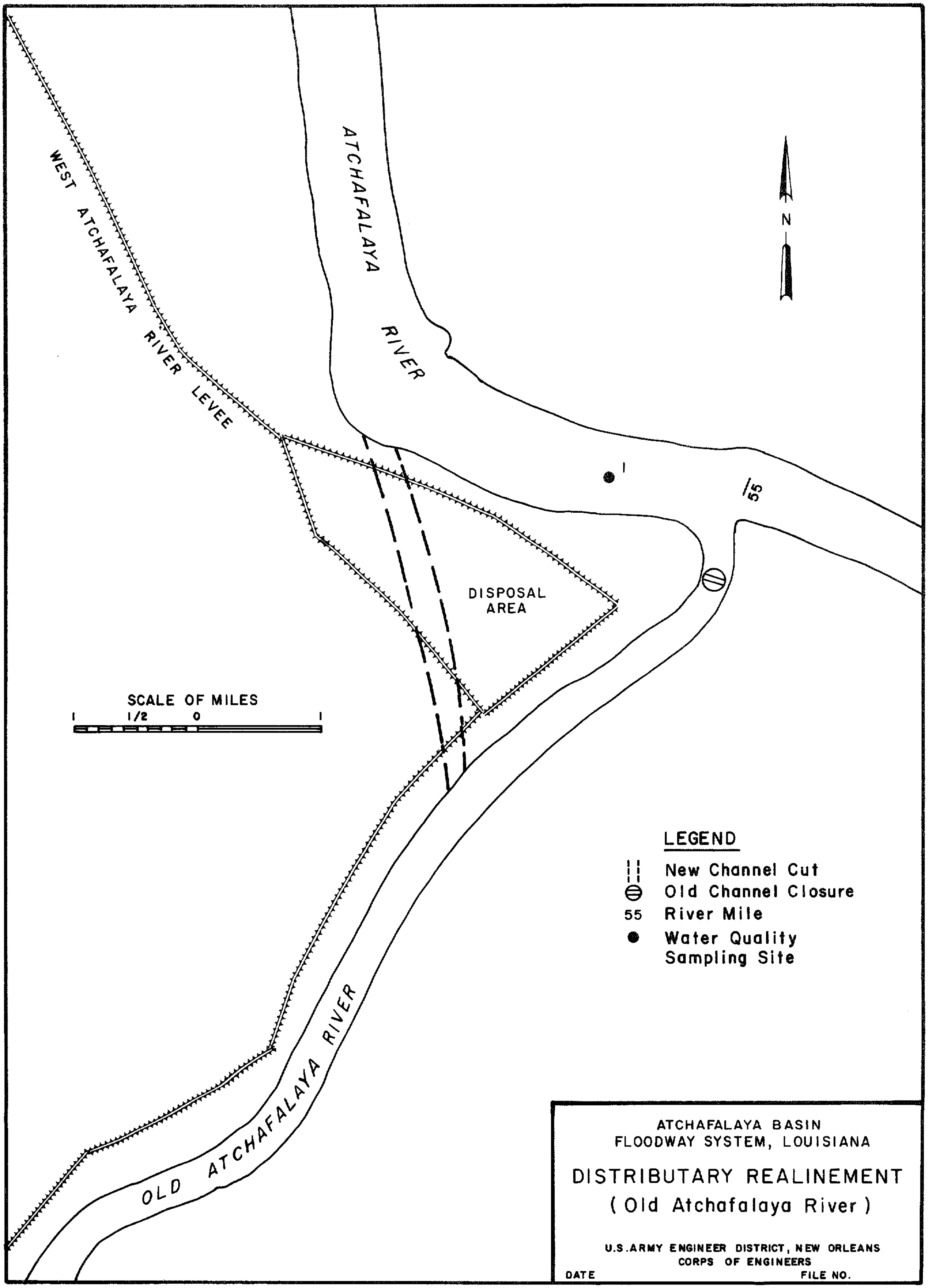
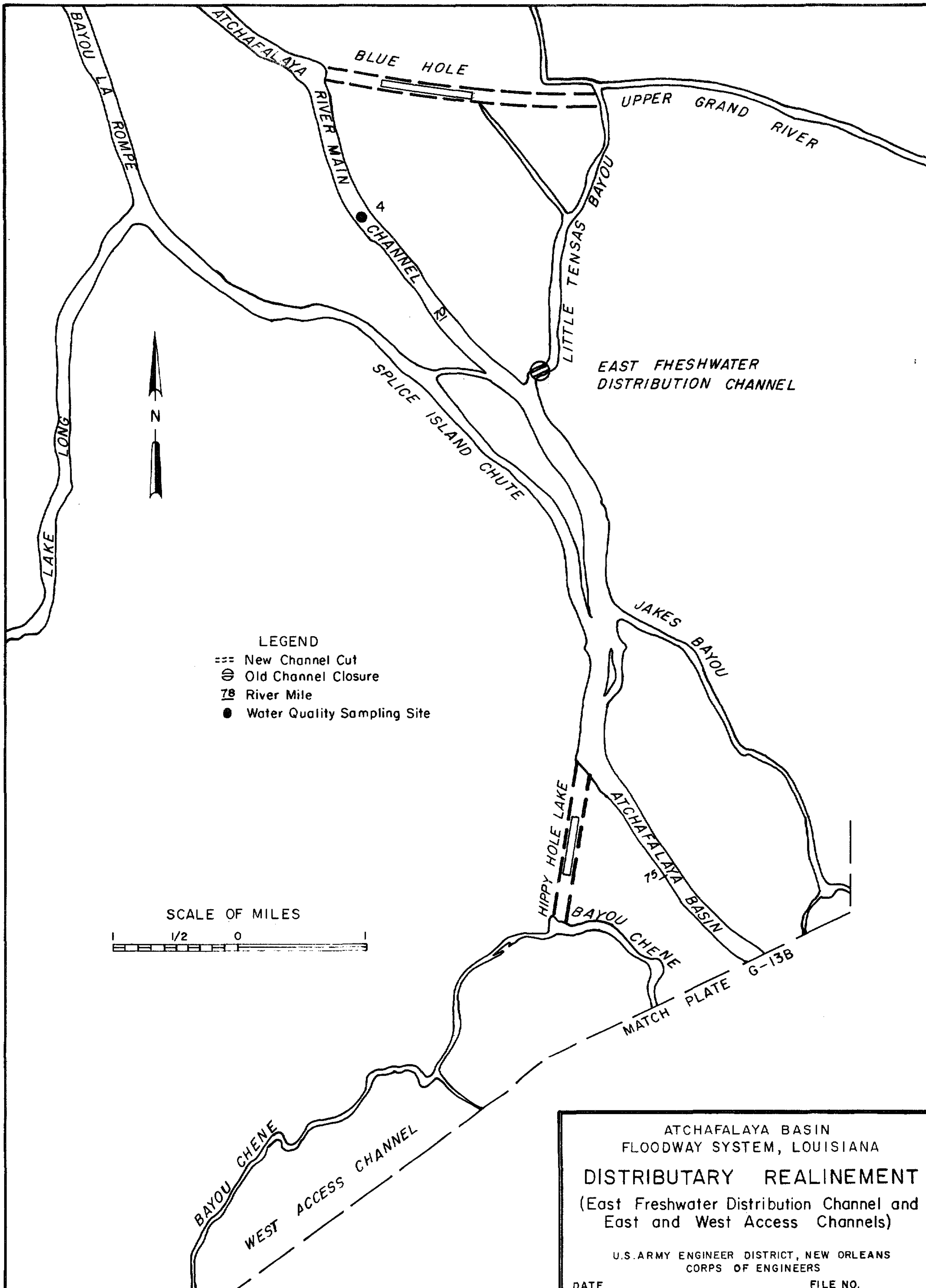

WEST ATCHAFALAYA RIVER LEVEE
ATCHAFALAYA RIVER
DISPOSAL AREA
1
55
N
SCALE OF MILES
1 1/2 0 1
LEGEND
New Channel Cut
Old Channel Closure
55 River Mile
Water Quality Sampling Site
OLD ATCHAFALAYA RIVER
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
DISTRIBUTARY REALINEMENT
(Old Atchafalaya River)
U.S.ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE G-12



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

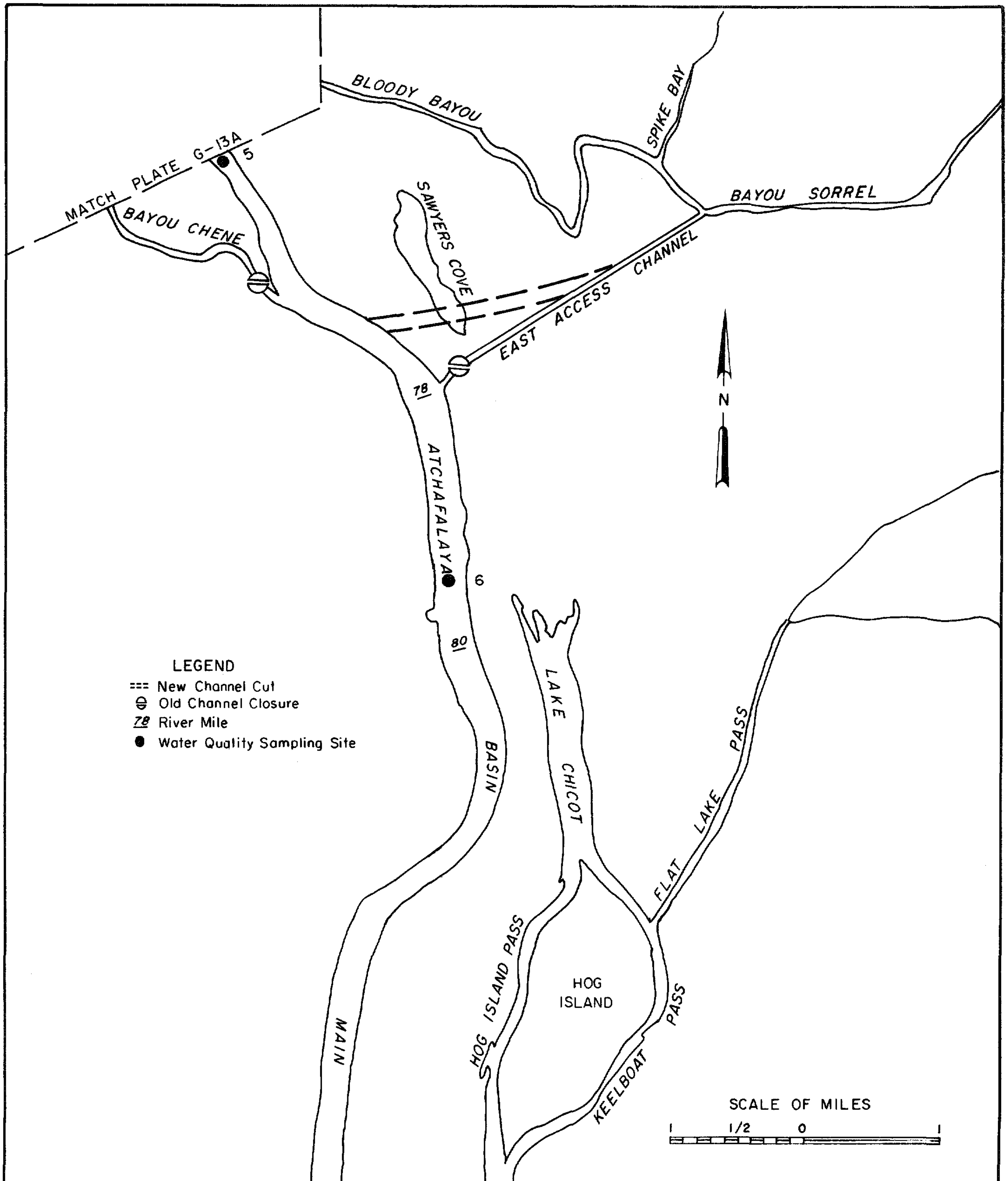
DISTRIBUTARY REALINEMENT

(East Freshwater Distribution Channel and East and West Access Channels)

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE G-13A



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

DISTRIBUTARY REALINEMENT
(East Freshwater Distribution Channel and East and West Access Channels)

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE G-13B

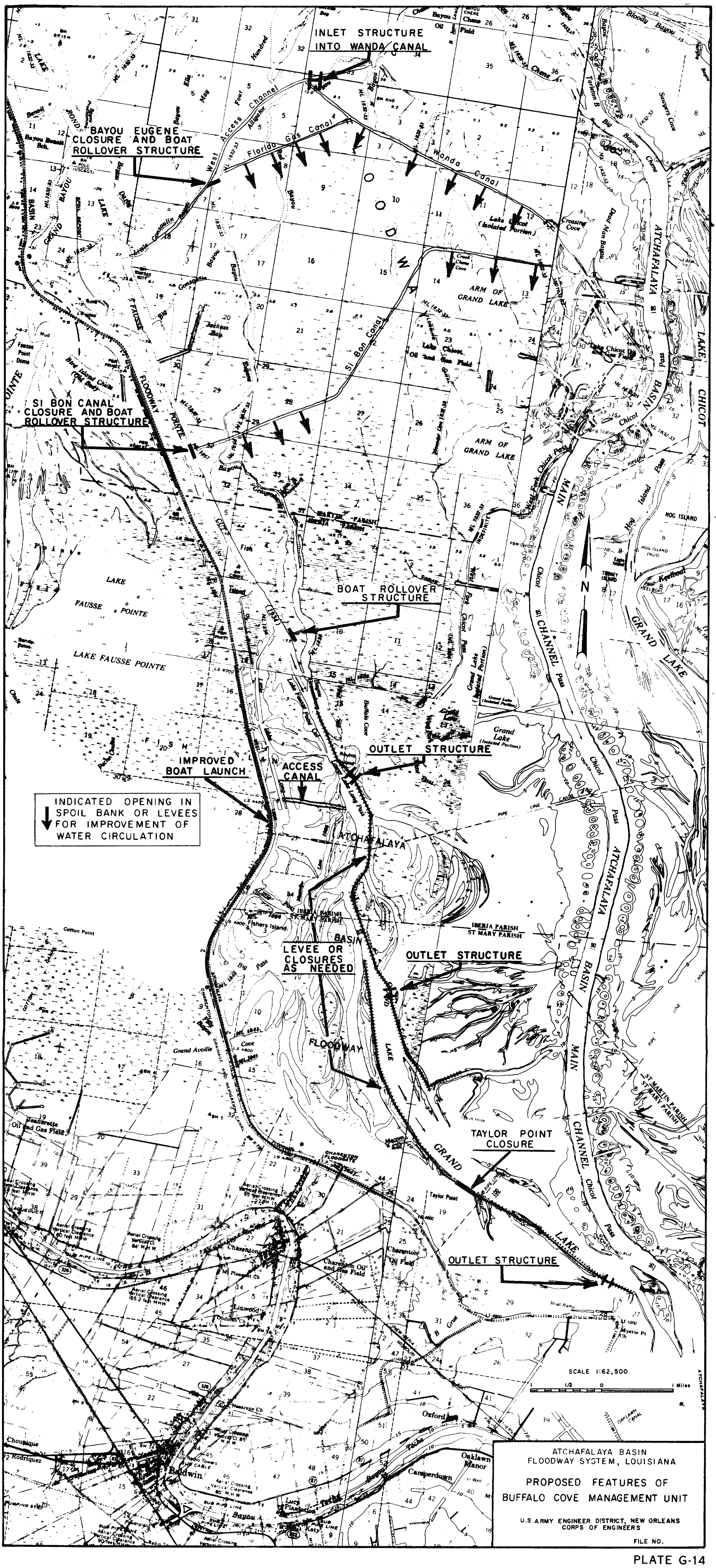

INLET STRUCTURE INTO WANDA CANAL
BAYOU EUGENE CLOSURE AND BOAT ROLLOVER STRUCTURE
SI BON CANAL CLOSURE AND BOAT ROLLOVER STRUCTURE
BOAT ROLLOVER STRUCTURE
IMPROVED BOAT LAUNCH
ACCESS CANAL
OUTLET STRUCTURE
INDICATED OPENING IN SPOIL BANK OR LEVEES FOR IMPROVEMENT OF WATER CIRCULATION
LEVEE OR CLOSURES AS NEEDED
OUTLET STRUCTURE
TAYLOR POINT CLOSURE
OUTLET STRUCTURE
Wanda Canal
Florida Gas Canal
West Access Channel
Si Bon Canal
ARM OF GRAND LAKE
LAKE FAUSSE POINTE
ATCHAFALAYA BASIN MAIN CHANNEL
GRAND LAKE
IBERIA PARISH
ST MARY PARISH
Charenton
Baldwin
Jeanerette Oil and Gas Field
SCALE 1:62,500
ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA
PROPOSED FEATURES OF BUFFALO COVE MANAGEMENT UNIT
U.S.ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS
FILE NO.

PLATE G-14

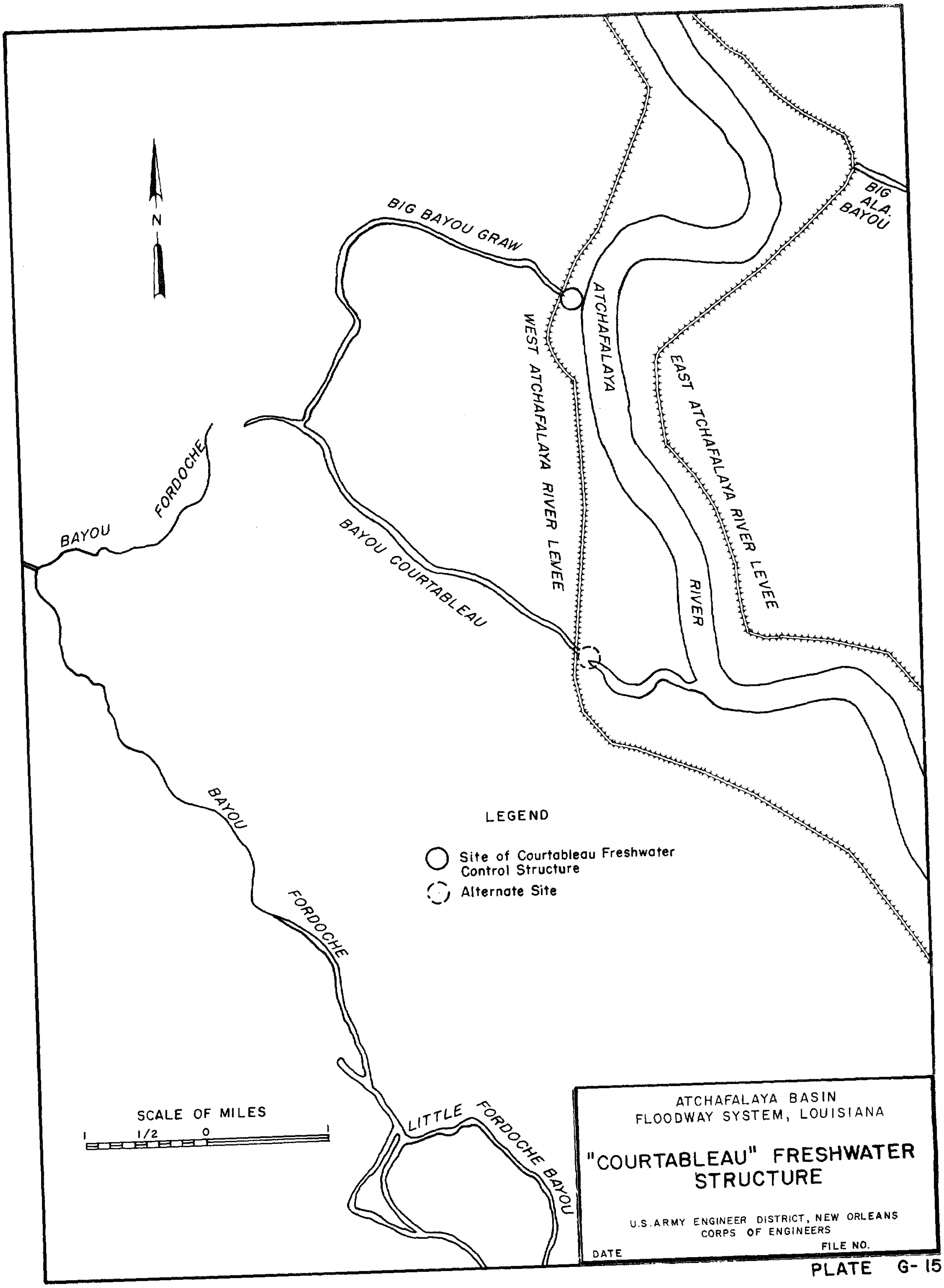
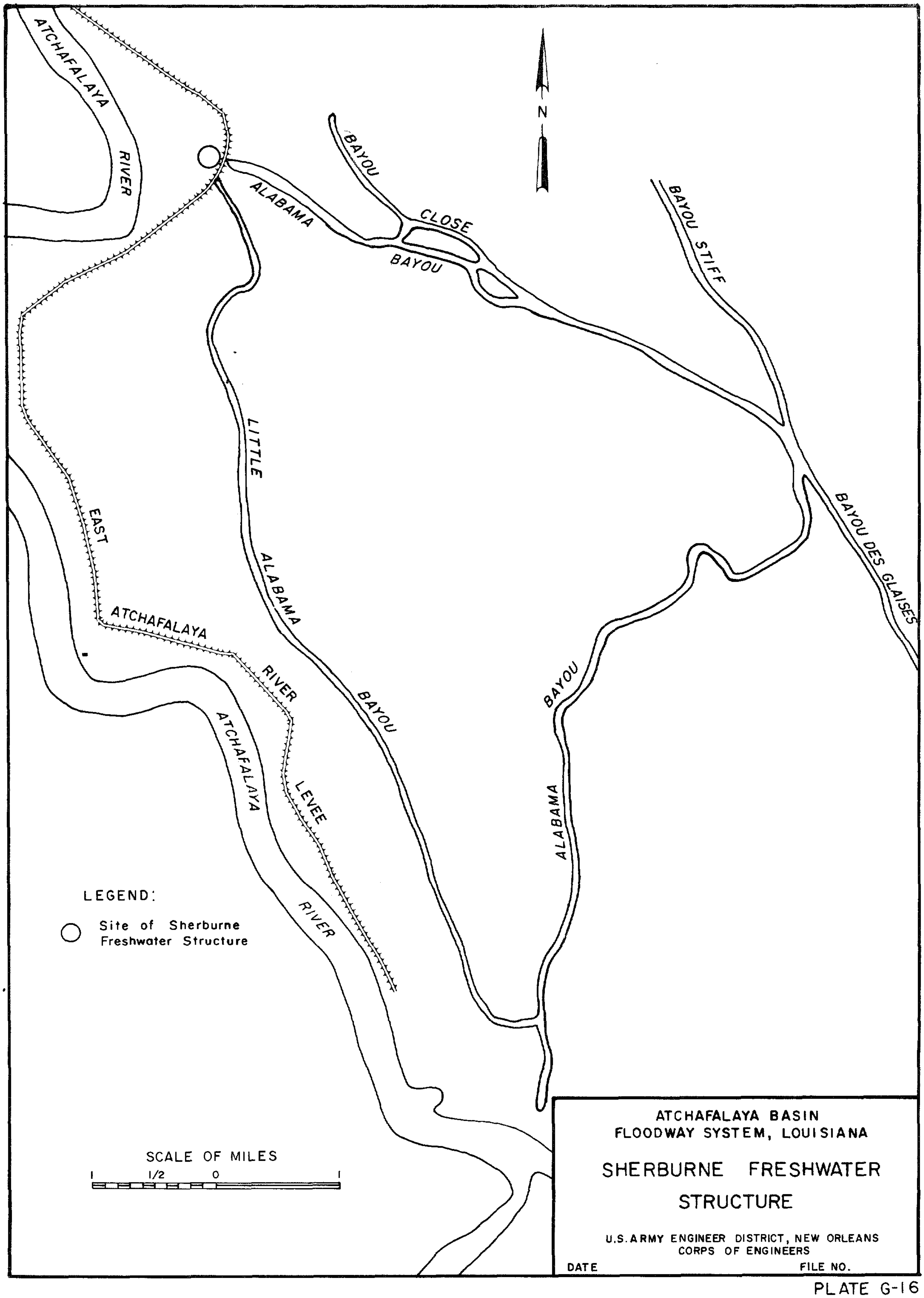

N
BIG BAYOU GRAW
ATCHAFALAYA
WEST ATCHAFALAYA RIVER LEVEE
EAST ATCHAFALAYA RIVER LEVEE
BIG ALA. BAYOU
RIVER
BAYOU FORDOCHE
BAYOU COURTABLEAU
BAYOU FORDOCHE
LITTLE FORDOCHE BAYOU
LEGEND
Site of Courtableau Freshwater Control Structure
Alternate Site
SCALE OF MILES
1 1/2 0 1
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
"COURTABLEAU" FRESHWATER STRUCTURE
U.S.ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE G-15


N
ATCHAFALAYA RIVER
ALABAMA BAYOU
BAYOU CLOSE
BAYOU STIFF
LITTLE ALABAMA BAYOU
EAST ATCHAFALAYA RIVER LEVEE
BAYOU DES GLAISES
BAYOU ALABAMA
ATCHAFALAYA RIVER
LEGEND:
Site of Sherburne Freshwater Structure
SCALE OF MILES
1 1/2 0 1
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
SHERBURNE FRESHWATER
STRUCTURE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

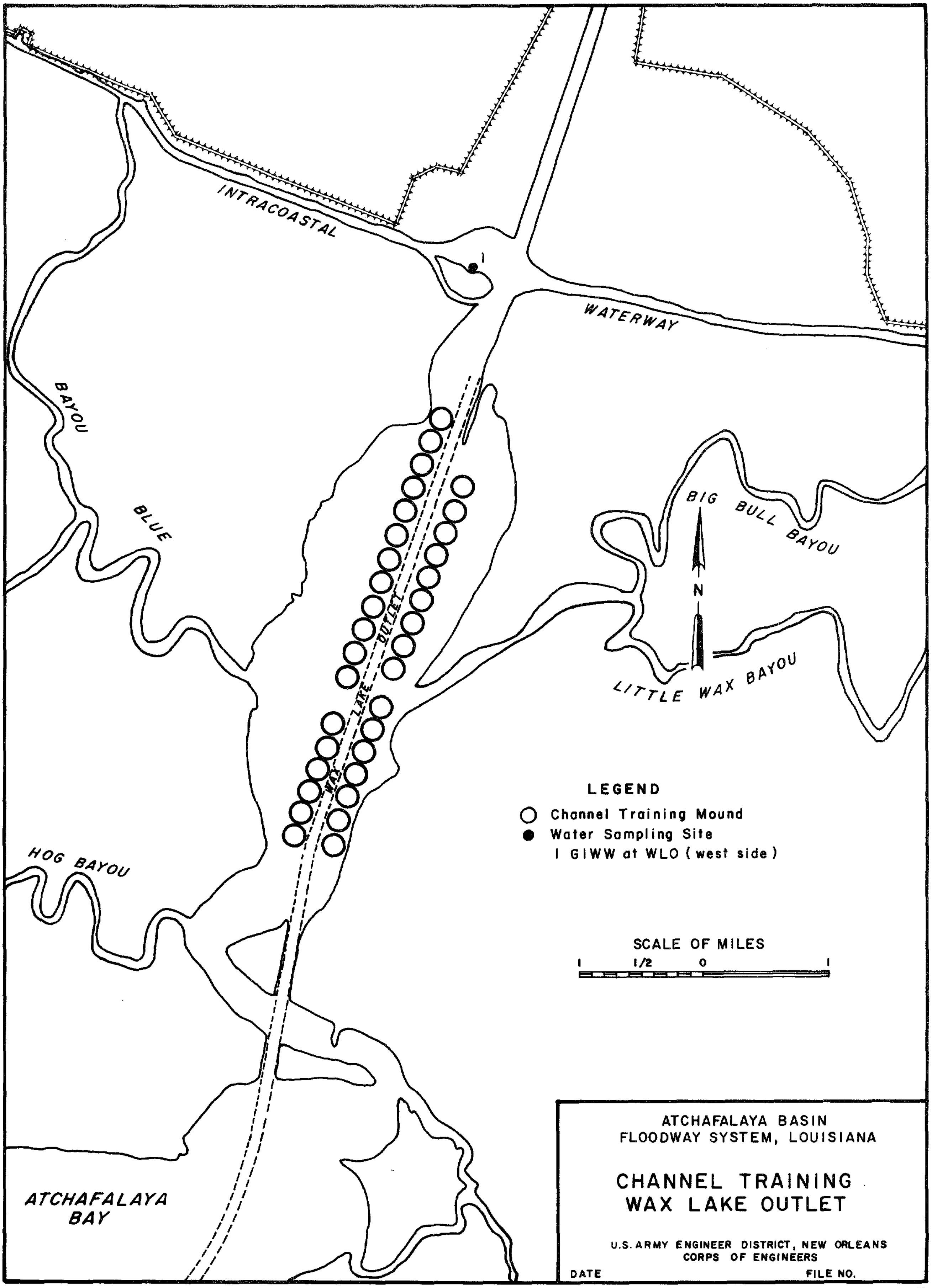
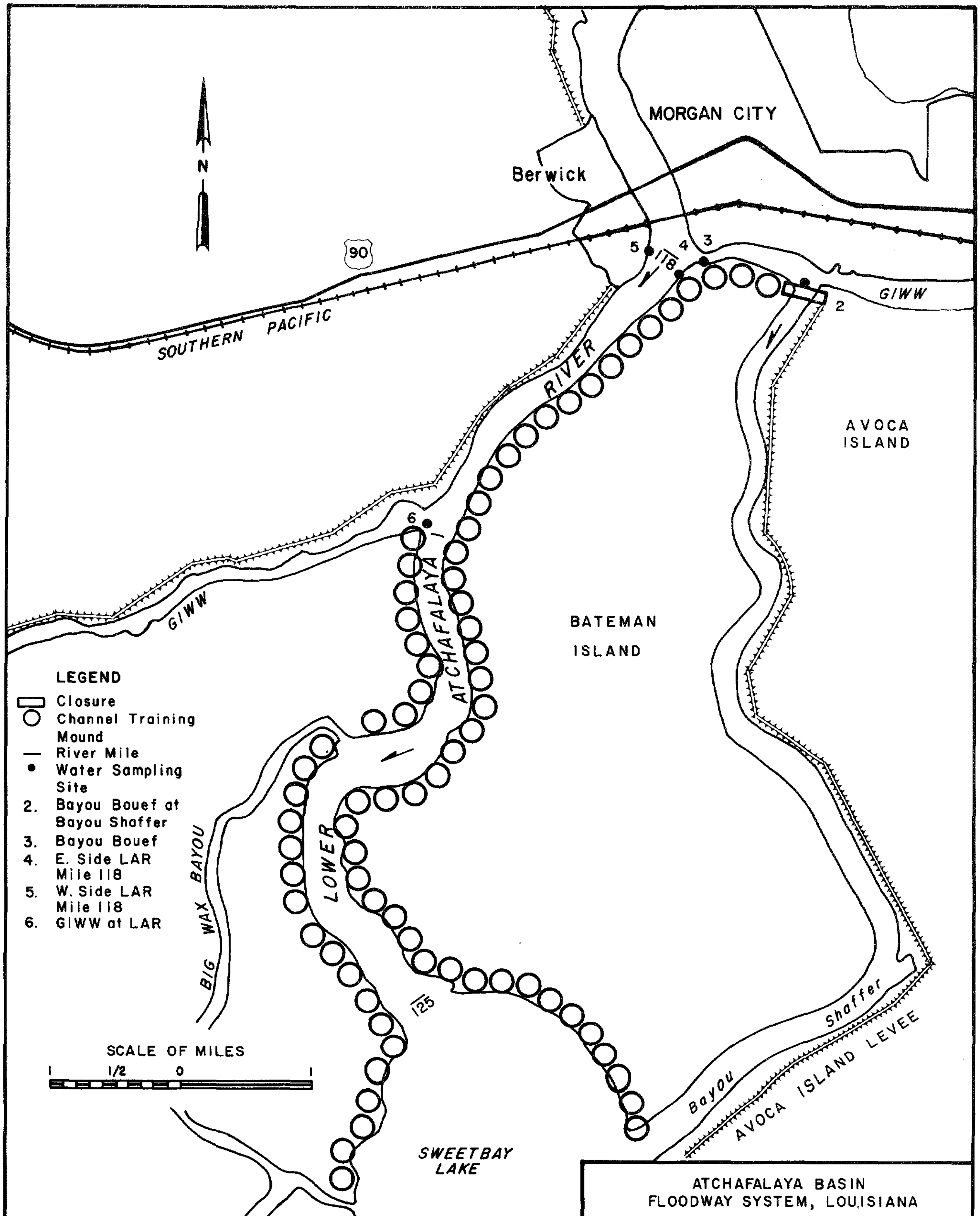

INTRACOASTAL
WATERWAY
1
BAYOU
BLUE
BIG BULL BAYOU
N
LITTLE WAX BAYOU
WAX LAKE OUTLET
LEGEND
Channel Training Mound
Water Sampling Site
1 GIWW at WLO (west side)
HOG BAYOU
SCALE OF MILES
1 1/2 0 1
ATCHAFALAYA BAY
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
CHANNEL TRAINING
WAX LAKE OUTLET
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE G-17

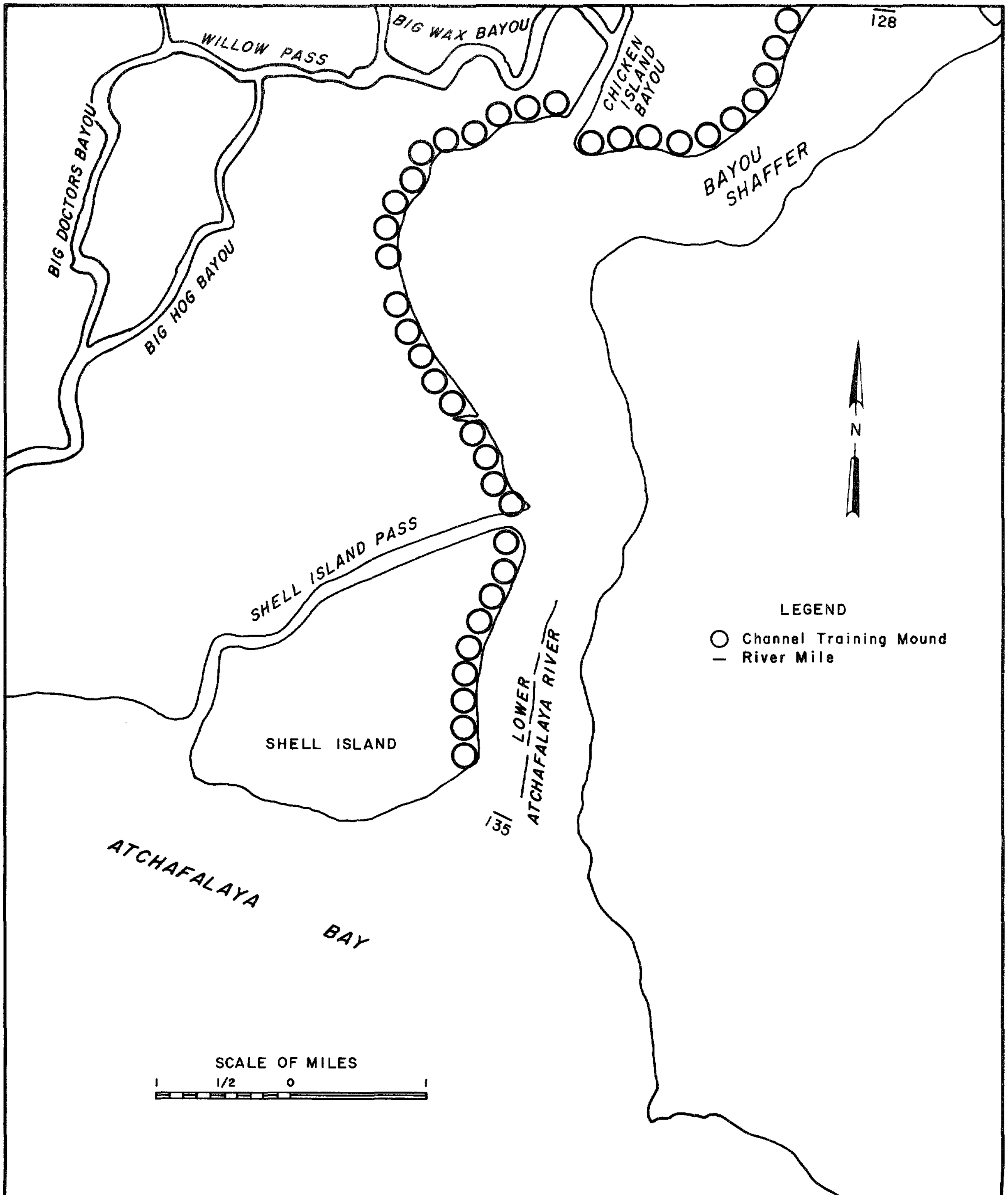


ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

CHANNEL TRAINING
LOWER ATCHAFALAYA RIVER
MILE 118 - 128

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

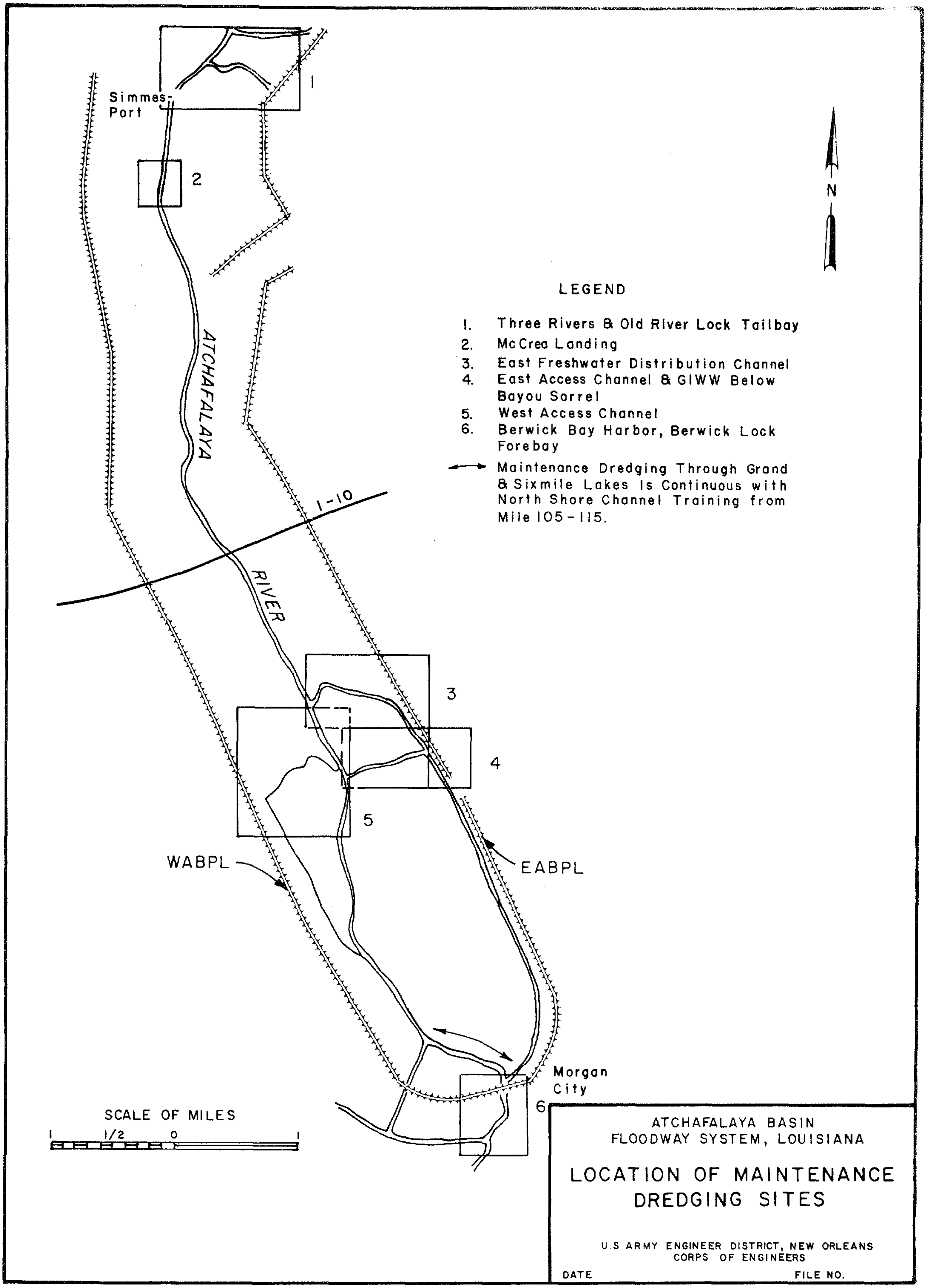
CHANNEL TRAINING
LOWER ATCHAFALAYA RIVER
MILE 128 - 135

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE

FILE NO.

PLATE G-19



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

LOCATION OF MAINTENANCE DREDGING SITES

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

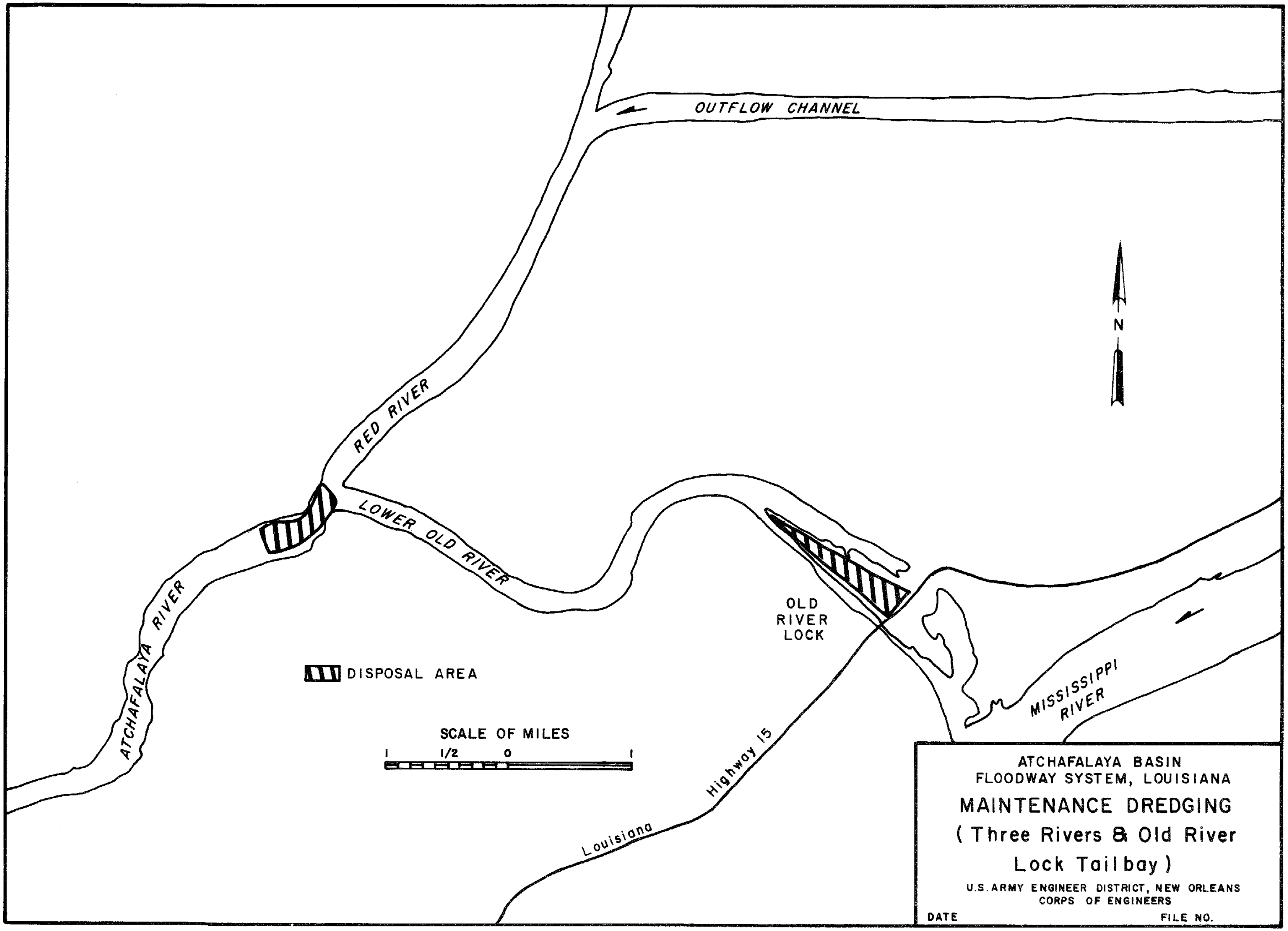
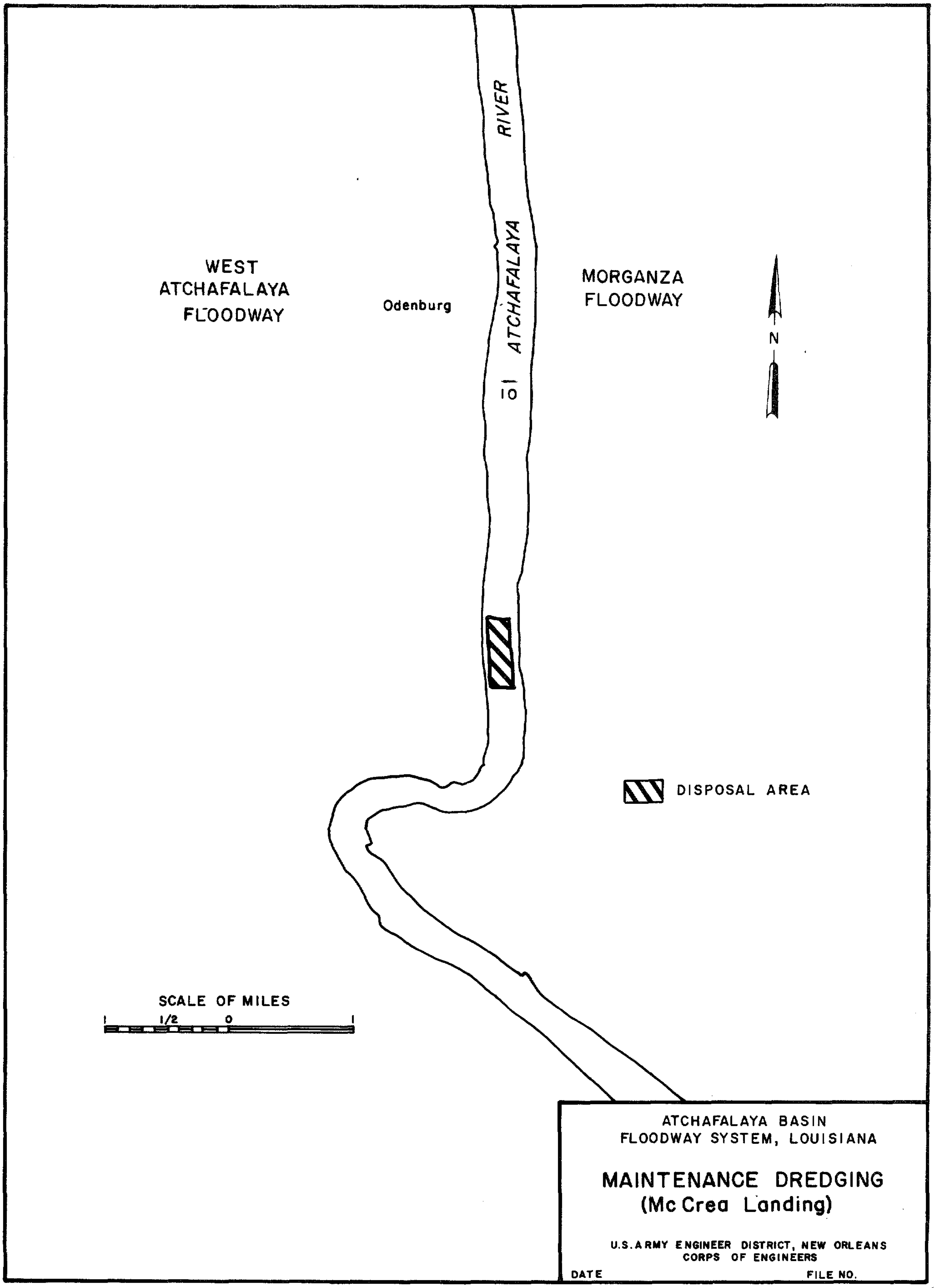
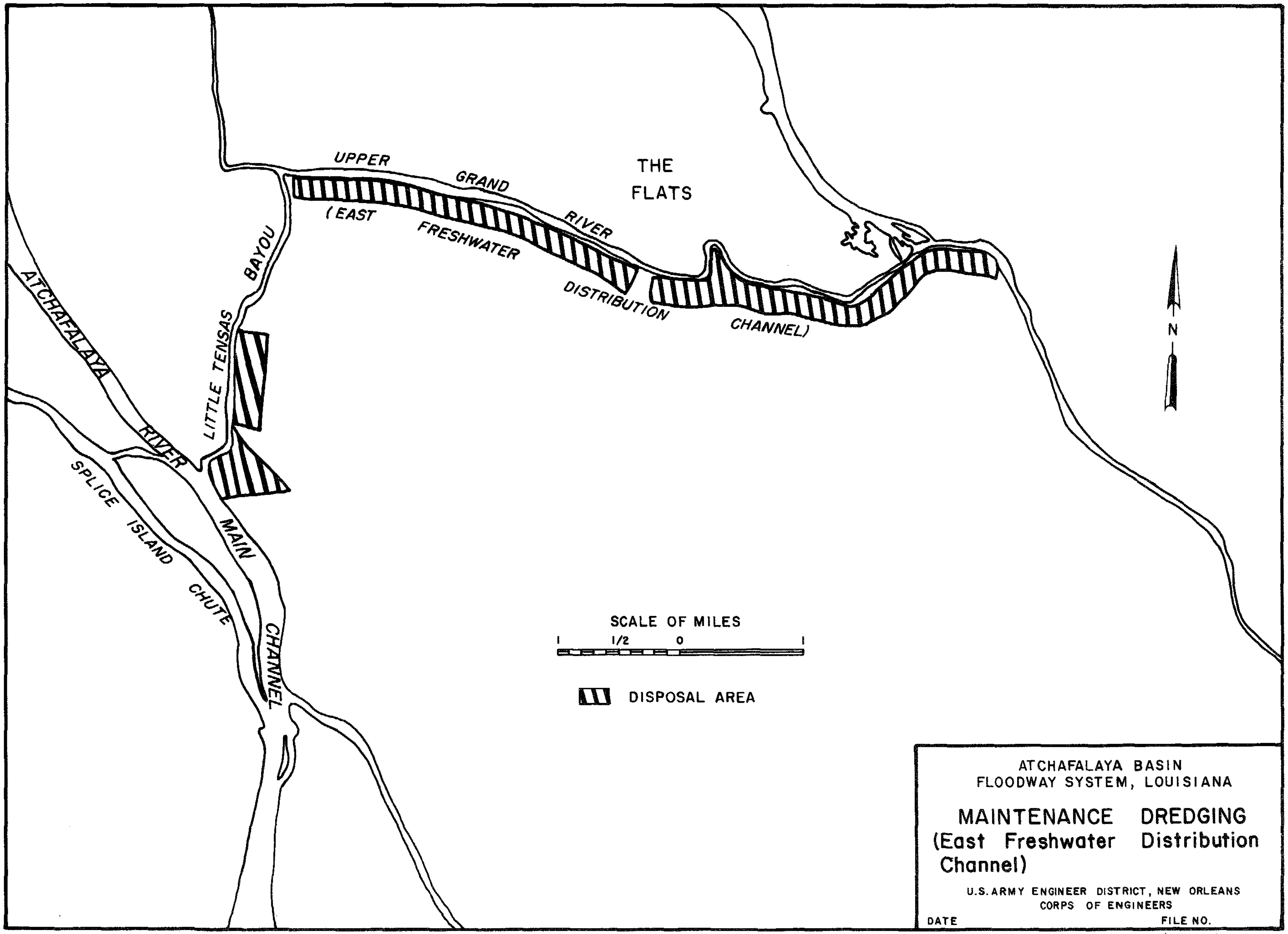

OUTFLOW CHANNEL
RED RIVER
LOWER OLD RIVER
ATCHAFALAYA RIVER
OLD RIVER LOCK
MISSISSIPPI RIVER
N
DISPOSAL AREA
SCALE OF MILES
1 1/2 0 1
Louisiana Highway 15
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
MAINTENANCE DREDGING
(Three Rivers & Old River Lock Tailbay)
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE G - 21


RIVER
ATCHAFALAYA
WEST
ATCHAFALAYA
FLOODWAY
Odenburg
MORGANZA
FLOODWAY
N
10
DISPOSAL AREA
SCALE OF MILES
1 1/2 0 1
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
MAINTENANCE DREDGING
(Mc Crea Landing)
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

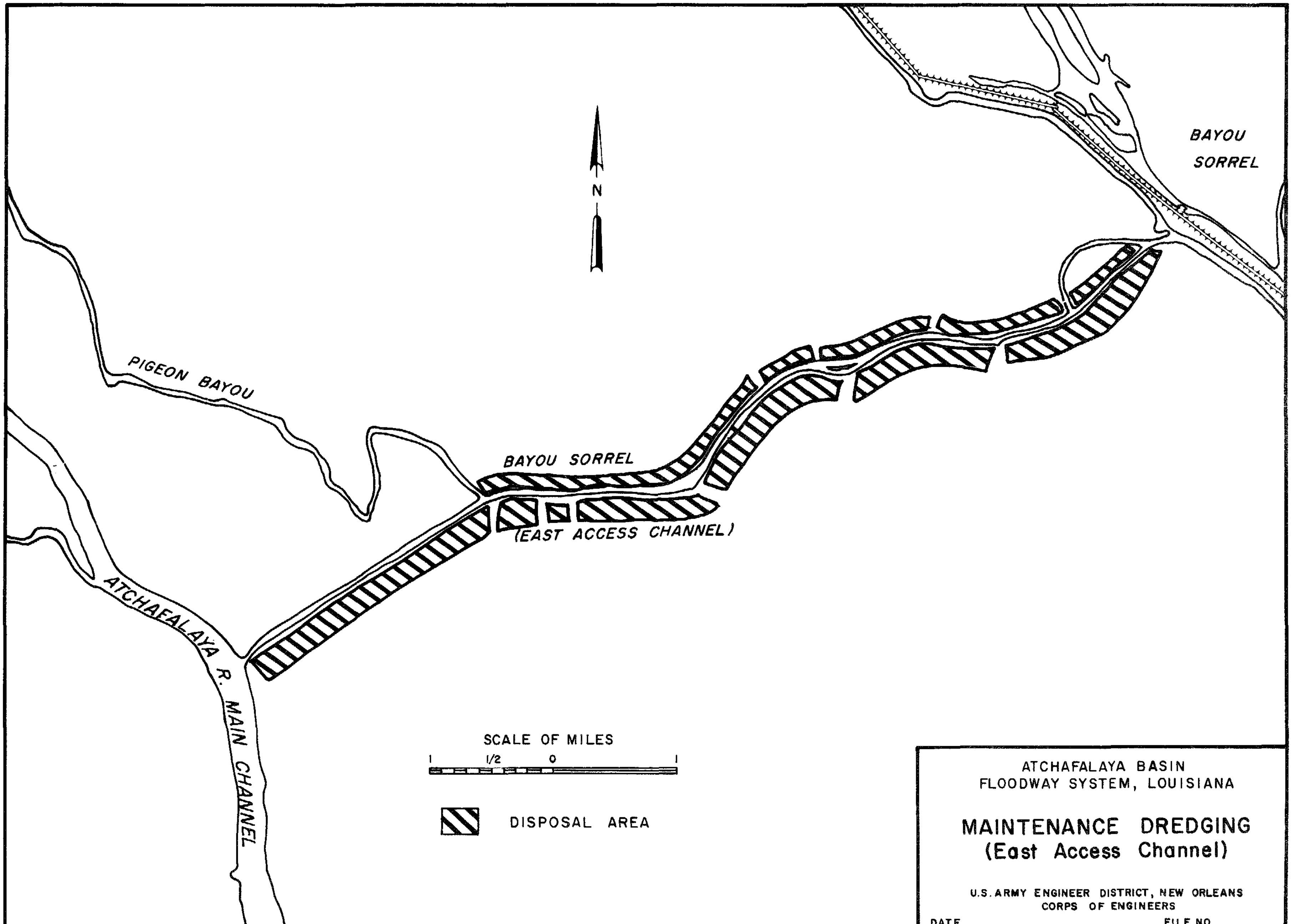
MAINTENANCE DREDGING
(East Freshwater Distribution Channel)

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE

FILE NO.

PLATE G-23



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

MAINTENANCE DREDGING
(East Access Channel)

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE G-24

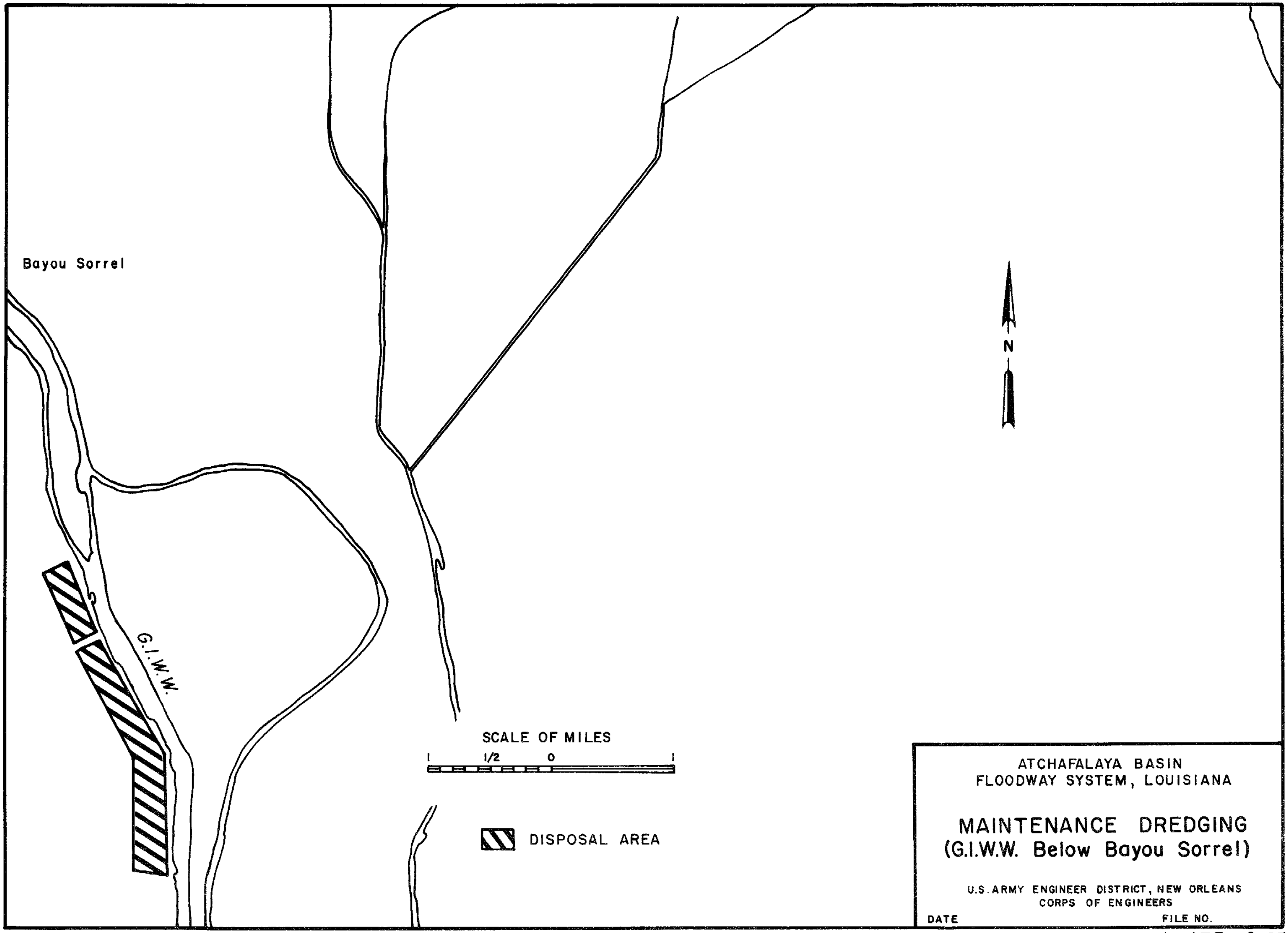
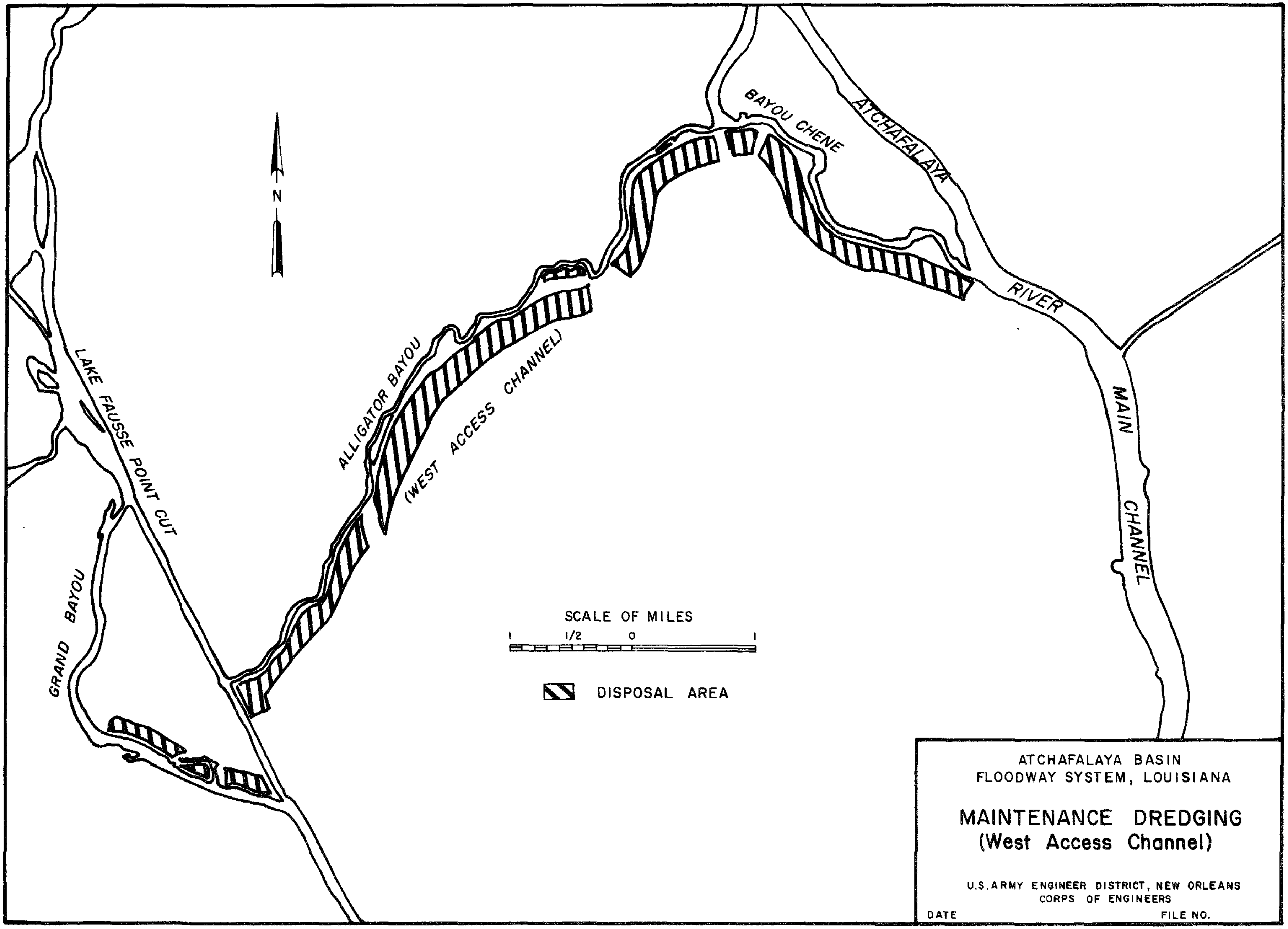

Bayou Sorrel
G.I.W.W.
N
SCALE OF MILES
1/2
0
DISPOSAL AREA
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
MAINTENANCE DREDGING
(G.I.W.W. Below Bayou Sorrel)
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE G-25



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

MAINTENANCE DREDGING
(West Access Channel)

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE G-26

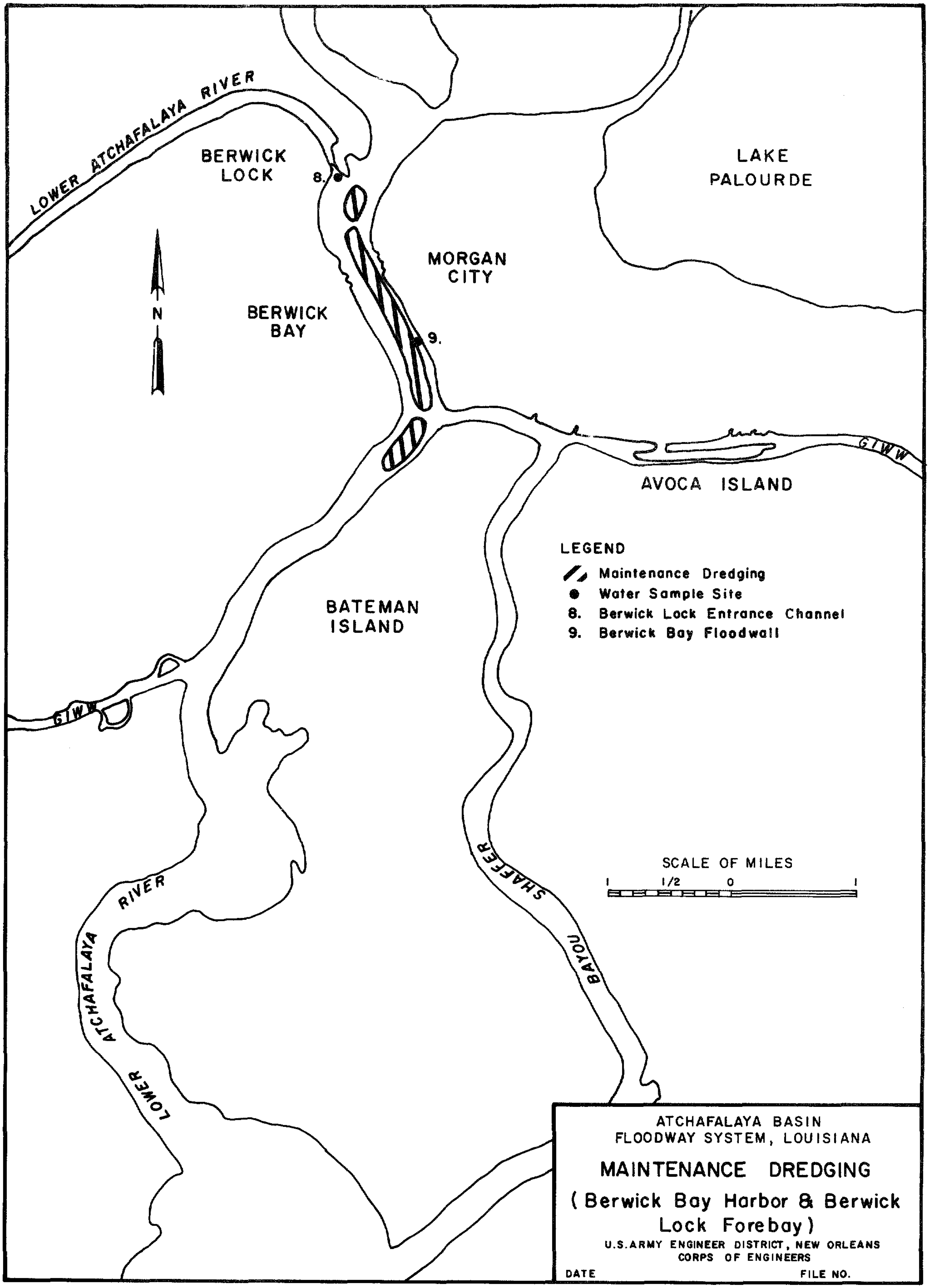

LOWER ATCHAFALAYA RIVER
BERWICK LOCK
8.
MORGAN CITY
LAKE PALOURDE
N
BERWICK BAY
9.
GIWW
AVOCA ISLAND
LEGEND
Maintenance Dredging
Water Sample Site
8. Berwick Lock Entrance Channel
9. Berwick Bay Floodwall
BATEMAN ISLAND
GIWW
SCALE OF MILES
1 1/2 0 1
SHAFFER BAYOU
LOWER ATCHAFALAYA RIVER
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
MAINTENANCE DREDGING
(Berwick Bay Harbor & Berwick Lock Forebay)
U.S.ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE G-27

APPENDIX H

ENDANGERED SPECIES ASSESSMENT

REVISED BIOLOGICAL ASSESSMENT OF ENDANGERED AND THREATENED SPECIES FOR THE ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA PROJECT

I. Introduction

This assessment was prepared for the US Fish and Wildlife Service (USFWS) and the US National Marine Fisheries Service (NMFS) to fulfill requirements of the US Army Corps of Engineers, New Orleans District (COE), in adhering to Section 7 of the Endangered Species Act Amendments of 1978. The COE, with input from the USFWS and the NMFS (see attached letters dated 11 February 1980 and 16 March 1981), prepared a list of endangered and threatened species that could occur within the project area and that could possibly be affected by the proposed project (Table 1). Possible project impacts upon each of these species were determined and are discussed in subsequent parts of this report along with pertinent information regarding the project setting, features of the recommended plan, methods used in determining impacts, and other relevant information.

TABLE 1
ENDANGERED AND THREATENED SPECIES THAT COULD BE AFFECTED BY THE PROPOSED ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA PROJECT

Endangered Species

1. Leatherback Sea Turtle (*Dermochelys coriacea*)
2. Kemps' Ridley Sea Turtle (*Lepidochelys kempii*)
3. Ivory-billed Woodpecker (*Campephilus principalis*)
4. Arctic Peregrine Falcon (*Falco peregrinus tundrius*)
5. Bald Eagle (*Haliaeetus leucocephalus*)
6. Eskimo Curlew (*Numenius borealis*)
7. Brown Pelican (*Pelecanus occidentalis*)
8. Bachman's Warbler (*Vermivora bachmanii*)
9. Red-cockaded Woodpecker (*Picoides borealis*)
10. Florida Panther (*Felis concolor coryi*)
11. West Indian Manatee (*Trichechus manatus*)
12. Sei Whale (*Balaenoptera borealis*)
13. Fin Whale (*Balaenoptera physalus*)
14. Sperm Whale (*Physeter catodon*)

Threatened Species

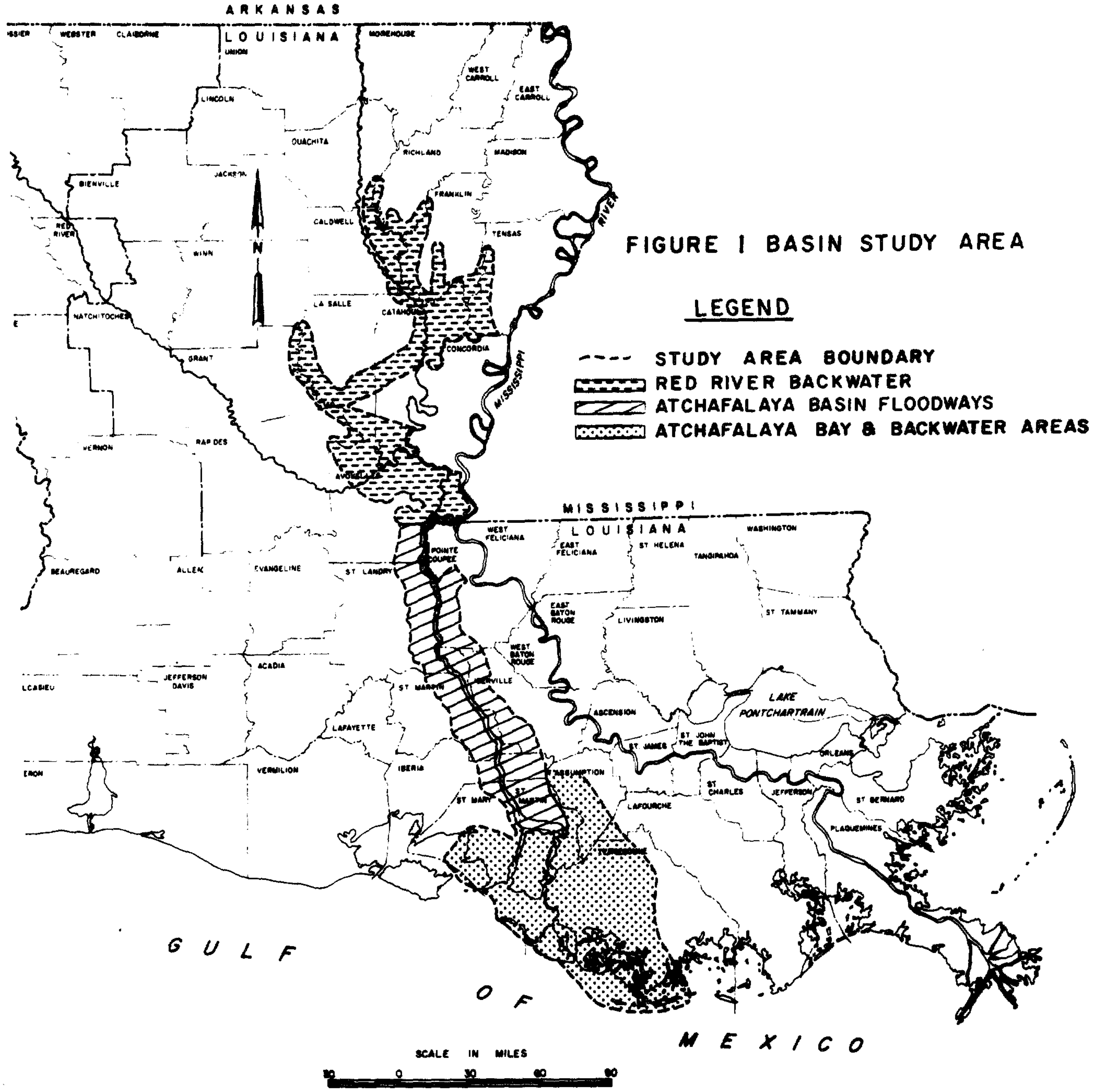
1. Loggerhead Sea Turtle (*Caretta caretta*)
2. Green Sea Turtle (*Chelonia mydas*)

II. Project Setting

The overall project area, which consists of the Red River backwater area, the Atchafalaya Basin Floodway system, and the backwater area northeast of Morgan City, is a vast lowland region confined by major meander belts of the Lower Mississippi and Red Rivers (Figure 1). The Atchafalaya River formed along the axis of this area about 500 years ago and today exists as the major distributary of the Mississippi River. The Atchafalaya Basin system conveys about 30 percent of the combined flows of the Red and Mississippi Rivers southward to the Gulf of Mexico through a system consisting of the Old River control structure, the river proper, and many interconnected channels, swamps, lakes, and marshes. The Atchafalaya River is bounded on the east and west by artificial levees, built in the 1930's and located at an average distance of about 7 miles from the main river channel. Within this area, impacts due to the proposed implementation of the recommended plan would occur primarily in the area south of US Highway 190. Within this project affected area (Figure 2), the predominant habitat types are bottomland hardwood forest, cypress-tupelo swamp, marshland, and cultivated farmland. Much of the project affected area is subject to occasional overbank flooding from the Atchafalaya River. In the leveed floodway portion south of Interstate Highway 10, overbank flooding is usually an annual event. Ths project affected area serves as highly valuable habitat for a variety of fish and wildlife species, as well as being one of the largest and most important semi-natural areas remaining in the United States. This area is heavily used for commercial fishing and for fish-and-wildlife-oriented recreational purposes. The human population of the project affected area is primarily rural and highly dependent upon the natural resources of soil, minerals, timber, fish, and wildlife for livelihood. A large part of this population is descended from French-speaking Acadian exiles who began coming to Louisiana in the 1770's. North of Interstate Highway 10 and along the Mississippi and Lafourche Ridges, farming activities are highly important. Considerable acreage here is devoted to the growth of soybeans. South of Interstate Highway 10, agriculture is less important, and the economy is based on commercial fishing and trapping, outdoor recreation, and the extraction of oil and gas.

III. Recommended Plan

The recommended plan was developed to meet the basic criterion of safely carrying the Mississippi River and Tributaries project flood to the Gulf of Mexico. In addition, it offers a balance with respect to contributions to national economic development and environmental quality. The basic features of this plan are illustrated in Figure 3 and are discussed in the following paragraphs by groups.


ARKANSAS
LOUISIANA
MISSISSIPPI
LOUISIANA
FIGURE I BASIN STUDY AREA
LEGEND
STUDY AREA BOUNDARY
RED RIVER BACKWATER
ATCHAFALAYA BASIN FLOODWAYS
ATCHAFALAYA BAY & BACKWATER AREAS
MISSISSIPPI RIVER
LAKE PONTCHARTRAIN
GULF OF MEXICO
SCALE IN MILES
30 0 30 60 90

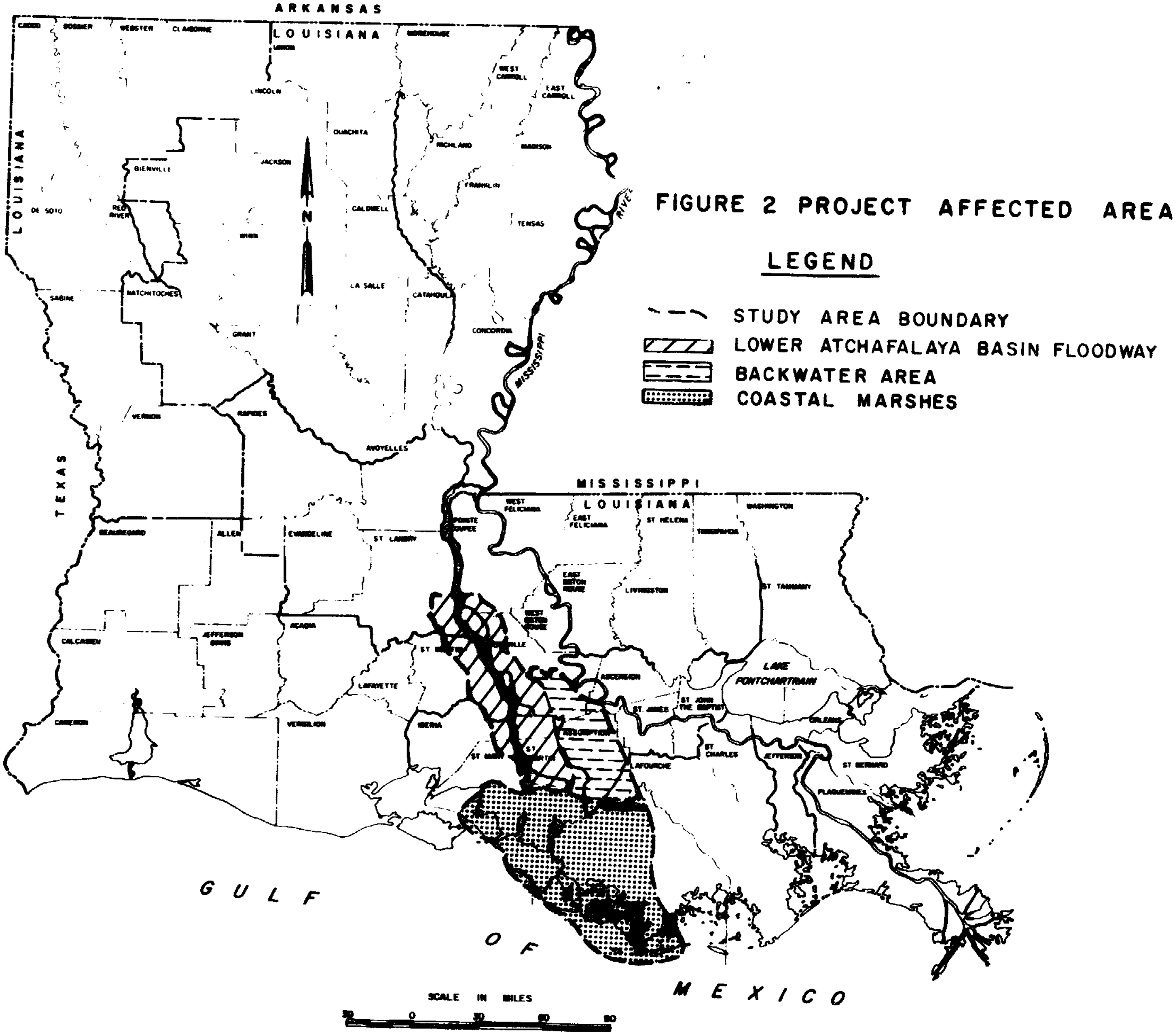


FIGURE 2 PROJECT AFFECTED AREA

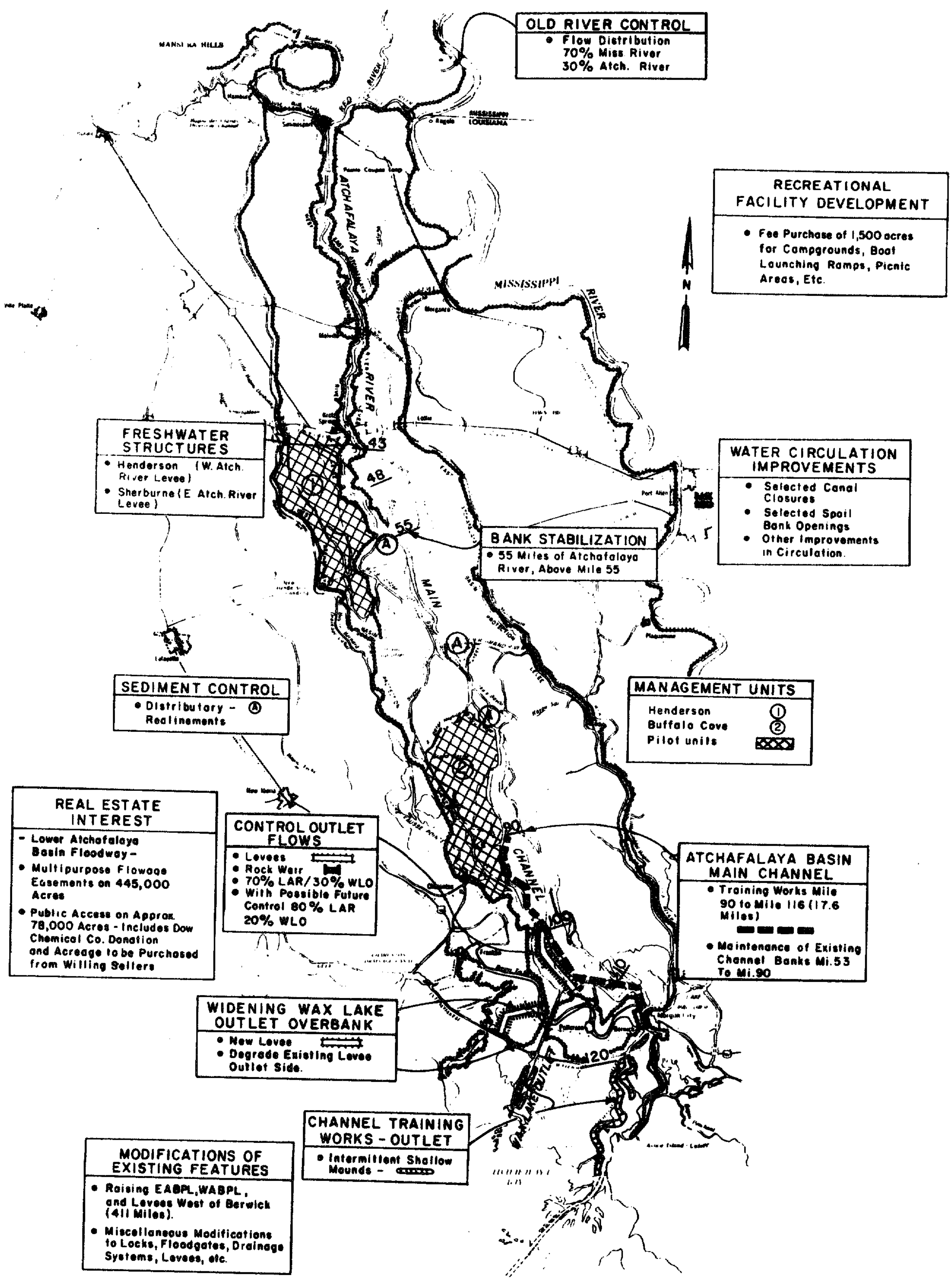


FIGURE 3 MAJOR FEATURES OF RECOMMENDED PLAN

GROUP I - ALTERNATIVES FOR OPERATION OF THE OLD RIVER CONTROL STRUCTURE

Maintain 70/30 Percent Distribution of Total Flows between the Mississippi and Atchafalaya Rivers below Old River, Respectively.

This is the present distribution and it would continue to be maintained on a daily basis.

GROUP II - ATCHAFALAYA RIVER MAIN CHANNEL DEVELOPMENT AND LEVEE RAISING ALTERNATIVES

Raising of the East and West Atchafalaya Basin Protection Levees, Atchafalaya River Levees, and Levees West of Berwick.

Levee raising has been an ongoing process since 1972. These levees would need to be raised approximately 6 feet in the southern portions and approximately 4 feet in northern portions. Once raised, the capacity of the lower floodway to safely pass the project flood would be assured.

Channel Training Alternative.

Reduction of sediment deposition in overbank areas would be accomplished by dredging 29,000,000 cubic yards (cy) of material from the river and depositing it on the banks to confine flows and sediment. These new banks would initially cover approximately 6,000 acres from river mile 90 to mile 116. Low back levees would prevent runoff of sediment into adjacent areas. There would be no gaps in the banks and they would be built to a height that would be overtopped during 50 percent of the years of project life. Future bank maintenance from mile 53 to mile 90 could become necessary if severe bank erosion occurred in this reach and repairs were needed to confine the river.

Bank Stabilization.

The banks of the Atchafalaya River would be stabilized where necessary by placement of rip-rap or articulated concrete mattresses from Simmesport to the head of Whiskey Bay Pilot Channel, a distance of 55 miles.

Minor Project Features.

This would include construction and maintenance of locks, culverts, and pumping stations. Maintenance dredging of freshwater and access channels would also be included.

GROUP III - SEDIMENT CONTROL ALTERNATIVES

Distributary Channel Realinements.

The major distributary channels of the Atchafalaya Basin main channel (Old Atchafalaya River, east and west access and east freshwater distribution channels) would be realined to reduce the entrance angle to between 30 to 45 degrees to reduce the volume of sediments being carried by these channels into overbank and open water areas. This would be accomplished by blocking the distributary near the main channel, while at the same time dredging a new entrance channel.

GROUP IV - MANAGEMENT UNITS AND RELATED FEATURES

Phased Implementation.

This feature would provide for the initial implementation of two management units, Buffalo Cove and Henderson, and based on detailed studies of the results of their operation, the development of others. Development of management units would require restriction of their natural outlets by constructing weirs and, in some cases, low level levees. Construction of new inlets at the upper end of each management unit would probably be necessary, as well as the closure of certain bayous and canals, and the improvement of circulation within the units. Rollovers for small boat access would be installed at some bayou and canal closures.

Freshwater Structures.

A freshwater diversion structure near river mile 48 would serve as an inlet for the Henderson management unit area. This structure would be a gated culvert designed to pass a maximum of 3,000 cubic feet per second (cfs) into Big Bayou Graw or a similar site nearby.

The Sherburne Freshwater Diversion Structure at river mile 43 would provide freshwater to the Alabama Bayou area. This gated culvert would pass a maximum of 3,000 cfs into Big Alabama Bayou.

GROUP V - ALTERNATIVE FLOODWAY LAND-USE PLANS

Real Estate Interest.

The recommended real estate features of the plan provide for those interests needed to serve three basic functions: flood control, environmental protection, and public access.

Flood Control.

The Flood Control Act of 1936 authorized the US Army Corps of Engineers to acquire certain flowage rights in the Lower Atchafalaya Basin. The Act further specified: "That no flowage easements shall be paid for by the United States over properties subject to frequent overflow in the Atchafalaya Basin below the approximate latitude of Krotz Springs." It was determined that about 68,000 acres in the Lower Atchafalaya Basin Floodway were subject to purchase of flowage easements under this Act. To date, those easements have been obtained on about 9,000 acres. The recommended plan proposes the purchase of flowage rights on the remaining 59,000 acres. In addition, the right to prohibit the construction of new permanently habitable structures and to prohibit or regulate contruction of other structures, including camps, would be acquired over all privately owned land (approximately 445,000 acres) in the lower basin except for the developed ridges. This right would assure the lower floodway's readiness for operation on short notice, preclude the need for Corps of Engineers emergency flood-fighting operations and associated Federal expenses within the basin, and insure no liability on the part of the Federal Government for the public health, safety and welfare by controlling industrial development that could prove hazardous to the public during floodway operations.

Environmental Protection.

Real estate interests proposed for protection of environmental values in the lower basin were developed in response to general study goals of the authorizing congressional resolutions and specific study objectives as defined by the Agency Management Group, i.e., to "retain and restore the unique environmental features of the floodways and maintain or enhance the long-range productivity of the wetlands and woodlands." In addition to those rights needed for flood control, the recommended plan proposes other rights specifically for environmental protection. These rights are considered necessary for preservation of fish and wildlife habitat and maintaining the "wet and wild" environmental appeal of the lower floodway. Such rights would include control over all excavation and landfill operations and allowance for extension of the time and duration of flooding by natural or artificial means. These rights would prevent or delay potential degradation of existing flowage patterns, prevent destruction of habitat and provide for water level control under the proposed management unit concept. Additional environmental rights would prohibit the conversion of land to other uses and would provide control over the method of cutting timber. The proposed land conversion control is directed at preventing destruction of fish and wildlife habitat, i.e., clearing of forests for the purpose of agricultural production of soybeans or other higher value economic pursuits, such as residential or industrial development. Control over timber would also be aimed at preserving habitat as well as maintaining the lower basin's environmental appeal by controlling clearcutting and promoting sustained yield forestry practices. A comprehensive multipurpose easement, or higher interest if mutually agreed upon, containing the cited environmental interests would be acquired over the entire 445,000 acres of privately owned land in the lower basin, except for the developed ridges.

Public Access.

The public access function was subdivided into two basic categories that relate to separate features of the proposed plan. The first, recreation development, was formulated in response to the study authorizing resolutions. The second, general public access, was developed in response to the Agency Management Group defined objective to "maximize public opportunity to observe and utilize the fish and wildlife resources of the floodway" and is based on recommendations of the Governor of the State of Louisiana.

For the recreational development feature, a total of 1,500 acres would be acquired in fee title in the proximity of the lower floodway to provide for the development of campsites, boat-launching ramps and other facilities complementary to outdoor recreational activities. Included would be a limited number of day-use or picnicking sites and 200 to 500 acres set aside for special and unique areas, such as rookeries.

The general public access feature would be accomplished by the following described state managed lands. At least 30,000 acres has been made available in the Lower Atchafalaya Basin Floodway through a donation to the state by the Dow Chemical Company of land in and around the floodway in excess of 40,000 acres. Additionally, at least 48,000 acres in the floodway would be made available by fee title acquisition from landowners identified as willing sellers. These proposed lands are associated with the environmental goal of maintaining or enhancing productivity of the habitat, i.e., allowing the management of timber for fish and wildlife habitat improvement, as well as preserving existing esthetic values to benefit the pubic access user.

For all new real estate interests acquired for project purposes, mineral rights would be retained by the landowner. Other real estate interests would be acquired as necessary for implementation of other project features.

GROUP VI - ALTERNATIVES FOR FLOODWAY OUTLETS AND DELTA BUILDING

Reestablish Approved Design Flow Distribution (Lower Atchafalaya River 80 Percent/Wax Lake Outlet 20 Percent).

Initially, present flows (70/30) would be maintained by a weir and low-level levee upstream of Wax Lake Outlet. If the ecosystem responded favorably, flows into Wax Lake Outlet would be further restricted in the future by modification of the weir for limiting the low to normal flows to 20 percent.

Widen Wax Lake Outlet Overbank.

A new levee would be built west of the existing levee along the west side of Wax Lake Outlet to form a new overbank outlet. Existing levees within the widened overbank area would be degraded to ground level.

Training Works below Morgan City.

This feature would provide for training works below Morgan City on both the Wax Lake Outlet and the Lower Atchafalaya River and a closure of Bayou Shaffer. Construction of the training works would require the dredging of approximately 16 miles of existing channel bottom areas and placing the dredged material in adjacent shallow water bottoms or on adjacent stream banks, leaving gaps between disposal areas to allow for continued development of the overbank marshes, for navigation access, and for pipelines.

GROUP VII - ALTERNATIVES TO REDUCE BACKWATER FLOOD DAMAGES EAST OF THE FLOODWAY

Delayed Action.

A decision on a solution to the backwater flooding problem would be temporarily delayed until completion of additional studies which would be designed to fully evaluate the impact of suggested solutions such as extension of the Avoca Island levee, ring levees, or some yet to be developed new alternative. In the interim, some relief from backwater flooding problems would be brought about by other plan features.

GROUP VIII - MANAGEMENT ENTITY

The District Engineer would be the sole jurisdictional authority to protect and oversee Federal interests in the Atchafalaya Basin Floodway System upon implementation of the proposed comprehensive multi-purpose plan. Recreational and environmental features of the plan would be operated and maintained by the appropriate Louisiana State agencies under license and lease agreements administered by the US Army Corps of Engineers. The District Engineer would continue to coordinate with other Federal agencies on special studies and collateral interests as required by Federal law and Corps of Engineers' regulations.

GROUP IX - MITIGATION MEASURES

No mitigation measures would be necessary.

IV. Study Methods

This assessment was completed following a two-year period of intensive study of the project area, which included numerous on-site visits, conversations with knowledgeable biologists, and a review of the available literature. No major difficulties were encountered in obtaining data; however, the vastness of the project area made it impossible to conduct a comprehensive survey to determine if all the listed species do, in fact, occur within the area.

V. Impact Assessment

Leatherback Sea Turtles.

The leatherback sea turtle is distributed throughout the tropical seas of the world and travels the farthest north of all sea turtles. This species is a powerful swimmer and is the most pelagic of the sea turtles and may be seen far out to sea.

Nesting, occurring from April to December in the United States, is confined to the coast of Florida. In 1962, one leatherback nest was discovered on Destin beach in northern Florida. Occurrences reported for the northern Gulf of Mexico include hatchlings sighted on the beaches in Walton and Okaloosa Counties, Florida, a report by Denver Wildlife Research Center personnel (National Fish and Wildlife Laboratory, 1981) that leatherbacks are seasonally abundant off Panama City, Florida; and two females netted by a fisherman off the southeastern coast of Louisiana in 1951.

It is unlikely that this sea turtle would occur in the project area. The leatherback appears to follow schools of its preferred food, the cabbage head jellyfish, *Stomolophus meleagris*. The low salinities of Atchafalaya Bay and adjacent bays might inhibit the occurrence of this jellyfish and, thereby limit the occurrence of leatherbacks in the project area.

Kemp's Ridley Sea Turtle.

Distribution of the Kemp's ridley sea turtle is limited to the Gulf of

Mexico. Adults nest from April to August during daylight hours on a single beach near Rancho Nuevo, Tamaulipas State, Mexico. Adults tagged on this beach have been subsequently recovered in the shrimp-rich areas of the Gulf and coastal waters of Louisiana and Campeche, Mexico. Some individuals of the populations may nest or try to nest elsewhere. In 1977, during an aerial survey, a small turtle was spotted on the sandy beaches of Timbalier Island, Louisiana. It may have been a female Kemp's ridley looking for a nesting site (National Fish and Wildlife Laboratory, 1981).

Nearshore gulf habitats are very important to this species. The Kemp's ridley is primarily a carnivore and a bottom-feeder. It prefers to eat crustaceans, and many of its recorded food items inhabit estuarine and inshore areas with silt substrates. Adults and subadults may feed in the highly productive white shrimp-portunid crab beds of Louisiana, from Marsh Island to the Mississippi Delta.

In addition to utilizing the shallow coastal areas for feeding, Kemp's ridley sea turtle may overwinter in a dormant state in the shallow waters of northern Florida and other estuarine systems within the Gulf. Although having not been reported in the project area (McGehee, personal communication), the Kemp's ridley is the most likely sea turtle to be found in Atchafalaya and East and West Cote Blanche Bays. This species has been seen along coastal localities of Vermilion and Terrebonne Parishes and in the Intracoastal Waterway in Cameron Parish (Keiser, 1976). Sea turtles are extremely tolerant of freshwater (McGehee, personal communication). Therefore, none of the salinity regimes, which could result from any changes through Wax Lake Outlet and the Atchafalaya River as predicted with the recommended plan, should adversely impact this species. It also appears that the predicted salinity regimes would not significantly affect shrimp production in the area. Thus, the shrimp beds in East and West Cote Blanche Bays would continue to be a possible food source for this sea turtle throughout the project life.

Loggerhead Sea Turtle.

The loggerhead sea turtles have a world-wide distribution in temperate and tropical waters. This sea turtle is a confirmed wanderer. It may be found in the warm waters of the continental shelf, in bays, lagoons, and estuaries. The former nesting range from North Carolina to Mexico is now restricted to North Carolina, Florida, and rarely, gulf coast islands. From April to August, a small portion of the population nests in the Gulf of Mexico. Most of this nesting has occurred in the Chandeleur Islands and the barrier islands of Mississippi and Alabama.

Loggerheads are primarily carnivorous. They forage for a variety of invertebrates and sea grasses in many habitats, including coral reefs, rocky places, an old boat wrecks.

The occurrence of this species in the project area is less likely than that of Kemp's ridley. However, loggerheads are reported to occur along coastal Louisiana from Southwest Pass to Marsh Island (Keiser, 1976). Its tolerance for a variety of salinities may allow this species to wander into Four League Bay, Atchafalaya Bay, East and West Cote Blanche Bays, and Vermilion Bay in search of food. The outflow change proposed as a part of the recommended plan should have no effect on sea turtle movement.

Green Sea Turtle.

The green sea turtle is distributed over a wide range of tropical waters. Adults migrate between nesting and feeding areas. Nesting time varies with locality but ranges between March and December. The closest nesting sites to the Gulf of Mexico are on the east coast of Florida and on the Yucatan Peninsula, Mexico.

Young green sea turtles are carnivorous but the adults are herbivourous. The adults frequent marine grass beds along the entire coast of the Gulf of Mexico.

Green sea turtles have not been sighted in the Atchafalaya Bay area. Indeed, this species seems to prefer rocky bottom substrates which are rare along the Louisiana coast. If they were to occur in the project area, the most likely areas for them to be would be near or in the submerged aquatic vegetation beds around Marsh Island and the Derniere Islands. These islands would not be affected by the recommended plan.

Ivory-billed Woodpecker.

This woodpecker formerly was a resident throughout the virgin bottomland forests and swamps of the entire project area. Its disappearance throughout virtually its entire range generally coincided with logging operations, although some evidence indicates that excessive collecting was a contributing factor in some areas (Tanner, 1942, as cited by National Fish and Wildlife Laboratory 1980). Apparently, the ivory-bill is a nomadic "disaster species", moving into areas where trees have been killed by fire, storms, insect attack, or flooding (Dennis, 1967, as cited by National Fish an Wildlife Laboratory, 1980). It appears that within the Mississippi Delta region, ivory-bill distribution was limited to the higher parts of the "first bottoms," which were rarely covered with water more than a few months each year (National Fish and Wildlife Laboratory, 1980a). This zone is characterized by a forest association in which the dominant trees are sweet gum, oak, and ash.

It is possible that a few ivory-bills still live within the project area. Since 1971, a number of unconfirmed sightings have been reported in the northern parts of the Lower Atchafalaya Basin Floodway (Dwight LeBlanc, personal communication). This region contains large areas of bottomland forest which could sustain a small remnant population.

The proposed plan would undoubtedly have significant impacts upon the ivory-bills remaining within the project area (if, in fact, they do remain). Two project features would be responsible for these impacts.

Environmental easements would have a beneficial impact since they would help maintain the existing bottomland forests on which the birds depend. Some lumbering of these forests would occur in the future and this could decrease habitat quality, but it appears that virgin forests are not necessary for the survival of this species (Dennis, 1967, as cited by National Fish and Wildlife Laboratory, 1980).

On the other hand, the recreational development features of this plan would have an adverse impact upon ivory-bills. This would occur because these features would greatly increase public usage of the areas which may be inhabited. As much as an annual one million user-day increase could occur. These increased visitations would increase the likelihood that accidental or deliberate shooting of the few remaining individuals would occur. Such shooting is thought by authorities, such as Herbert Stoddard and Whitney Eastman, to have been the primary reason that these birds were originally reduced to near extinction. These same authorities believed that ivory-bills had a better chance for survival in a situation where large land holdings owned by timber companies was the rule (Eastman, 1958, as cited by National Fish and Wildlife Laboratory, 1980). It should be noted that the location of one of the reported sightings of this bird is within the tract of land donated to the State of Louisiana by Dow Chemical Company.

In summary, this plan may have net adverse effects upon the ivory-billed woodpecker if, in fact, they do still exist within the project area.

Arctic Peregrine Falcon.

This bird occurs within most of the project area only during migration. It does, however, occur as an occasional winter resident along the Gulf Coast portions of the area south of Morgan City. The primary reason for the peregrine's decline and endangered status appears to be the effects of pesticide poisoning upon reproduction (National Fish and Wildlife Laboratory, 1980b).

It is probable that this bird would be benefited by the proposed plan. This would be due to the environmental easement feature that would prevent expansion of agricultural activity within the Lower Atchafalaya Basin Floodway. This would help prevent an increase in pesticide and other pollutant concentrations in the food supply of these birds on the wintering grounds along the coastal portions of the project area.

Bald Eagle.

Bald Eagles occur within the project area both as migrants and as winter and spring residents. Eggs are laid during November or December and young hatch during January or February. Generally, both adults and juveniles leave the area by early summer. Nests are usually constructed close to water in living cypress trees. Fourteen nest sites are known to exist within the project area and most of these are located adjacent to the Terrebonne Parish marshlands in the southernmost part of the project area (Dugoni, 1980). Two features of the recommended plan could affect these birds.

Environmental easements would benefit eagles in the same way as was discusssed previously for the arctic peregrine falcon by helping prevent increased pollution in the lower parts of the project area.

Recreational development features would adversely affect eagles by increasing the numbers of persons present in the project area. This could lead to increased disturbance of nest sites and increased possibility of accidental or deliberate shooting. Shooting has been the most frequent single cause of death among autopsied bald eagles throughout the entire United States (Coon et al., 1970, as cited by Griffin et al., 1980).

In summary, it is concluded that the recommended plan would have no net impact upon eagles.

Eskimo Curlew.

This shorebird occurs within the project area only as a transient during the spring migration from South America northward to the Arctic. Several confirmed sightings have been made along the Louisiana coastal area. The most probable time this bird would be present is in March (Greenway, 1958, as cited by National Fish and Wildlife Laboratory, 1980). The project area contains little habitat that is suitable for this species. Some use of intertidal areas along the gulf coast might occur.

It seems highly unlikely that the recommended plan could have any impacts upon these birds.

Eastern Brown Pelican.

The historic range of the eastern brown pelican included the entire Louisiana coast. The pelicans nested on several barrier islands and at sites in the Mississippi Delta. By 1963, no pelicans were nesting in Louisiana. The likely causes of the population decline include weather, vandalism, disease, predation, starvation, and extremely high chemical pollution.

A breeding population of brown pelicans in Louisiana originated from young birds transplanted from Florida. Breeding began in Barataria Bay in 1971; and although a pesticide, endrin, killed 40 percent of the population in 1976, today a viable breeding population utilizes Queen Bess Island in lower Barataria Bay (Hines, personal communication; Clapp et al., 1981).

Brown pelicans usually feed in shallow nearshore and estuarine waters. The birds can range as far as 50 miles from their nesting area in search of food. During non-nesting times, they range farther. In the summer, the pelicans follow and feed on mullet and menhaden while they school in Barataria Bay. In the winter, the birds feed from the Timbalier Islands to the Mississippi River Delta.

Presently, brown pelicans are rarely seen in Atchafalaya and adjacent bays. As the population continues to increase, excluding any unforeseen catastrophe, the pelicans may begin to feed in the project area. Because these animals are extremely mobile, they can avoid any areas of disturbance to search elsewhere to feed. Any work done in Atchafalaya Bay should not adversly impact the brown pelican. Some beneficial impacts could occur due to the environmental easement feature of the recommended plan, which would help reduce pesticide pollution due to agricultural runoff.

Bachman's Warbler.

This small warbler is known to have occurred in Louisiana in the past (Lowery, 1974a) but few confirmed sightings have been made in recent years. Nesting occurs in bottomland hardwood forests. Much of the project area contains habitat that could be used by these birds. If any of these birds still occur within the project area, then it is probable that the environmental easement feature of the recommended plan would be highly beneficial to them as these easements would insure the preservation of large areas of suitable habitat.

Red-Cockaded Woodpecker.

This woodpecker is an inhabitant of pine forests. No suitable habitat of this type occurs within those parts of the project area that would be affected by the recommended plan. These birds would, therefore, be expected to occur only as transients. It seems very unlikely that the recommended plan could have any effects upon these birds.

Florida Panther.

The Florida panther may occur wherever its principal prey, the white-tailed deer, occurs. Since much of the project area contains a significant deer population, panthers could occur throughout the area. Two apparently authentic sightings have been made recently. One occurred near Butte la Rose in 1973 (LeBlanc, personal communication) and the other near the Attakapas Wildlife Management Area in 1979 (Watson, personal communication).

Two features of the recommended plan could affect panthers. Environmental easements would be highly beneficial since they would help preserve the forest habitat needed by deer, the panther's main food source. On the other hand, the recreational development features of this plan would probably not benefit the panther as they would increase human presence in the area, which could lead to increased likelihood of death or injury due to shooting. Since only a few panthers occur within the area, the death or injury of a single animal due to increased human presence could be significant.

The net project impact to the Florida panther in the project affected area is difficult to ascertain. The increase in bottomland hardwood acreages over future-without project conditions and the subsequent increase in deer population (food supply) would certainly benefit panther populations. On the other hand, the increase in public recreation could be detrimental. Since Florida panthers are very wary, gunshot injury or mortality should not be high and this detrimental impact could be offset by the projected increase in deer population and habitat protection. Therefore, any net negative impact on the Florida panther should be minimal.

West Indian Manatee.

The range of the West Indian Manatee is from North Carolina to Veracruz, Mexico. The manatee appears to prefer areas where there is mixing of saltwater and freshwater. In the United States, the winter distribution is confined primarily to the warmer rivers and coastal areas of peninsular Florida. During the summer, the manatees disperse from the warm water refugia and travel north to western Florida and North Carolina. Individuals which have been sighted in Louisiana are most likely manatees that have traveled north from Veracruz and Tamaulipas, Mexico (Lowery, 1974b). Sightings in Louisiana include one in Lake Catherine, Orleans Parish, May 1943; one in a bayou near Baton Rouge, 1975; and one in the Atchafalaya swamp, spring 1978 (Anomymous, 1978).

Manatees are herbivorous and eat a wide variety of vegetation. Their preferences are submergent, emergent, and floating vegetation in that order.

The occurrence of the West Indian manatee in the project area is very unlikely, although individuals have been sighted in the river and swamp in the past. Atchafalaya and adjacent bays are areas of salinity mixing, and abundant and diverse vegetation types grow in the waters. Therefore, the major limiting factors to the manatees' existence in Louisiana waters are the water temperature and the total lack of warm water refugia. If manatees occur in the project area during the warm water months, then no project features would be likely to affect them.

Sei Whale.

This whale occurs in nearshore and offshore waters of the western North Atlantic Ocean. They are migratory and move south in October to their winter range in the Caribbean and northeast and southeast Gulf of Mexico (Leatherwood et al., 1976). The only information about this species' occurrence in the northern gulf are three strandings. One of these strandings occurred in 1956 near the mouth of Fort Bayou northeast of Boothville, Plaquemines Parish, Louisiana.

Fin Whale.

This whale is a cosmopolitan species and occurs in the North Atlantic Ocean from Greenland to the Caribbean. The whales summer in northern waters and move south in October to their winter range along the coast of Florida and in the Gulf of Mexico (Leatherwood et al., 1976). In the northern Gulf, fin whales have been sighted almost every month of the year except for December and January (Schmidly, 1981). Strandings in Louisiana have not been documented since publication of the report of Lowery (1974b). The last stranding occurred in 1968 west of Venice.

Fish and Wildlife Service personnel (US Fish and Wildlife Service, personal communication) have not sighted any fin whales in the northern gulf. It is unlikely that any feature of the proposed project would impact this species.

Sperm Whale.

This species was once numerous enough in the Gulf of Mexico to support a whaling industry for 160 years. Whaling records showed that the whales were present in the north central Gulf from April through July and in central Gulf in March (Lowery, 1974b; Schmidly, 1981). However, because strandings of whales have occurred every month in the Gulf, a separate population stock could exist there.

Strandings and sighting are recorded from along the west coast of Florida and from along the Louisiana, Texas, and Mexico coasts. A stranding occurred on 6 November 1960, near Pass a Loutre (Lowery, 1974b). Recent sightings include three females and one calf at the 100-meter depth profile off the northern Texas coast, in August 1979 (Fritts and Reynolds, 1981), 14 sperm whales in 978 meters of water 40 miles south of South Pass, in August 1980, and four sperm whales in

548 meters of water off Marsh Island, in October 1980.

Although strandings and sightings of this species occur frequently, this whale is mostly confined to deep water and is rarely observed from the coast. It is unlikely that any of the project features would impact this species.

VI. SUMMARY AND CONCLUSIONS

The overall results of this evaluation are summarized in Table 2. From this, it can be seen that 12 species would not be affected by the recommended plan, two species could be affected beneficially, and two species could be affected adversely because of increased public usage of the area.

Because of the proposed increase in public recreation in the Atchafalaya Basin, an extensive public education program should be initiated by the responsible agencies to inform recreationists of the presence and importance of all endangered and threatened species. This educational program should also warn recreationists of existing state and Federal statues protecting endangered species and the violation penalties associated with those statues.

TABLE 2

SUMMARY OF RESULTS OF ENDANGERED AND THREATENED SPECIES
ASSESSMENT FOR THE PROPOSED ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA PROJECT

	Significant Project Impacts			Net Impact		
Species	None	Beneficial	Adverse	No Effect	May Affect Beneficially	May Affect Adversely
Leatherback Sea Turtle	X			X		
Kemp's Ridley Sea Turtle	X			X		
Loggerhead Sea Turtle	X			X		
Green Sea Turtle	X			X		
Ivory-billed Woodpecker		X	X			X
Artic Peregrine Falcon		X			X	
Bald Eagle		X	X	X		
Eskimo Curlew	X			X		
Brown Pelican	X			X		
Bachman's Warbler		X			X	
Red-cockaded Woodpecker	X			X		
Florida Panther		X	X			X
Florida Manatee	X			X		
Sei Whale	X			X		
Fin Whale	X			X		
Sperm Whale	X			X		

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United States Department of the Interior
FISH AND WILDLIFE SERVICE
75 SPRING STREET, S.W.
ATLANTA, GEORGIA 30303

FEB 11 1980

Mr. James F. Roy
Chief, Planning Division
U. S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160

Dear Mr. Roy:

We have reviewed the project area of the Atchafalaya Basin Floodway (Log number 4-3-80-A-72) as requested in your letter of January 9, 1980.

We concur with your letter and the attached list of endangered and threatened species which may occur in the project area with the following changes. The red-cockaded woodpecker (Picoides (=Dendrocopos) borealis) occurs in portions of Catahoula, Ouachita, Grant, and LaSalle Parishes. It should, therefore, appear on the list. You should also be aware that the American alligator (Alligator mississippiensis) is listed as an endangered species in all parishes of the project area with the following exceptions: the alligator is listed as a threatened species south of U.S. 190 in Pointe Coupee, St. Landry, St. Martin, Iberville, and Assumption Parishes. It is listed by similarity of appearance only in Iberia, St. Mary, and Terrebonne Parishes. [1]

In future correspondence please refer to the appropriate log number.

Once it is determined that listed or proposed species may be present, Section 7(c) requires Federal agencies to provide a biological assessment for the species which are likely to be affected. The biological assessment shall be completed within 180 days after the date on which initiated, before any contracts for construction are entered into, and before construction is begun. We do not feel that we can adequately assess the effects of the proposed action on listed and proposed species or Critical Habitat without a complete assessment. The following information should be included:

1. Results of a comprehensive survey of the area.

2. Results of any studies undertaken to determine the nature and extent of any impacts on identified species.

3. Agency's consideration of cumulative effects on the species or its Critical Habitat.

4. Study methods used.

[1] Due to a change in the law taking place after this letter was written, the alligator is no longer considered either endangered or threatened in the project area.

5. Difficulties encountered in obtaining data and completing the proposed study.

6. Conclusions of the agency including recommendations as to further studies.

7. Where an impact is identified to proposed and listed species or Critical Habitat, a discussion of efforts that will be taken to eliminate any adverse effects.

8. Any other relevant information.

The Fish and Wildlife Service representative who will provide you with assistance is Mr. Fred Bagley, Endangered Species Specialist, U. S. Fish and Wildlife Service, 200 East Pascagoula Street, Suite 300, Jackson, Mississippi 39201, telephone FTS 490-4900, commercial (601) 969-4900.

After your agency has completed and reviewed the assessment, you should send a copy of the assessment with your determination of "no effect" or "may affect" on any of the listed species. If the determination is "may affect", you shall initiate consultation by a written request to the Regional Director, Fish and Wildlife Service, Richard B. Russell Federal Building, 75 Spring Street, S. W., Suite 1282, Atlanta, Georgia 30303.

Your attention is also directed to Section 7(d) of the 1978 Amendment to the Endangered Species Act, which underscores the requirement that the Federal agency and the permit or license applicant shall not make any irreversible or irretrievable commitment of resources during the consultation period which in effect would deny the formulation or implementation of reasonable alternatives regarding their actions on any endangered or threatened species.

For your information and assistance we have enclosed a copy of the interim definitions and two "step down processes" for general guidance.

Sincerely yours,

Richard N. Smith

Acting Deputy Regional Director

Enclosures

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Region
9450 Koger Boulevard
St. Petersburg, FL 33702

March 16, 1981 F/SER64:CDJ

Mr. James F. Roy
Chief, Planning Division
Department of the Army
New Orleans District
Corps of Engineers
P.O. Box 60267
New Orleans, LA 60160

Dear Mr. Roy:

This is in reply to your letter of February 17, 1981, which requested information about species which are listed or proposed to be listed as threatened or endangered as provided by the Endangered Species Act of 1973. Your area of interest is the Atchafalaya Basin Floodway Area.

As provided in Section 7(c) of the Endangered Species Act Amendments of 1978 and 1979 (see enclosed copy), the National Marine Fisheries Service (NMFS) is required to furnish a list of endangered or threatened species, both proposed and listed, which are under NMFS jurisdiction, that may be or are present in the area involving Federal construction activities. The list enclosed with your letter is not correct. Enclosed is a corrected list of endangered or threatened species that may ocur in the proposed project area. All consultations under Section 7 involving sea turtle aquatic areas are the responsibility of NMFS, while such consultations involving sea turtle nesting beaches are the responsibility of the U. S. Fish and Wildlife Service (FWS). All Section 7 consultations involving the manatee, an endangered marine mammal, are the responsibility of FWS.

For purposes of providing interim guidance, the National Marine Fisheries Service considers "construction projects" to mean any major Federal action which significantly affects the quality of the human environment designed primarily to result in the building or erection of man-made structures such as dams, buildings, roads, pipelines, channels, and the like. This includes Federal actions such as permits, grants, licenses, or other forms of Federal authorization or approval which may result in construction.

Upon receipt of the National Marine Fisheries Service's species list, the Federal agency authorizing, funding, or carrying out the construction action is required to conduct a biological assessment for the purpose of identifying listed species and species proposed for listing which are likely to be affected by such action. The biological assessment shall be completed within 180 days after receipt of the species list, unless it is mutually agreed to extend this period.

When conducting a biological assessment, the Federal agency should minimally:

(1) Conduct an on-site inspection of the area affected by the proposed activity or program. This may include a detailed survey of the area to determine if the species are present or are present at other times of the year, and whether suitable habitat exists for either expanding the existing population or potential reintroduction of populations;

(2) Interview recognized experts on the species at issue, including those within the National Marine Fisheries Service, the U.S. Fish and Wildlife Service, State conservation departments, universities and others who may have data not yet found in scientific literature;

(3) Review literature and other scientific data to determine the species' distribution, habitat needs and other biological requirements;

(4) Review and analyze the effects of the proposed action on the species, in terms of individuals and populations, including consideration of the cumulative effects of the proposed action on the species and its habitat;

(5) Analyze alternative actions that may provide conservation measures.

At the conclusion of the biological assessment, as described above, the Federal agency should prepare a report documenting the results. The report should include a discussion of the study methods used and any problems encountered or any other relevant information.

If the biological assessment reveals that the proposed project may affect listed species, the formal consultation process shall be initiated by writing to the Regional Director, National Marine Fisheries Service, 9450 Koger Boulevard, Duval Building, St. Petersburg, Florida 33702. If no effect is evident, there is no need for further consultation. We would, however, appreciate the opportunity to review your biological assessment.

March 1981

Endangered & Threatened Species and Critical Habitats Under
NMFS Jurisdiction

Atchafalaya Basin, Louisiana

LISTED SPECIES

Kemp's (Atlantic) ridley sea turtle	Lepidochelys kempi	Endangered
Green sea turtle	Chelonia mydas	Threatened
Leatherback sea turtle	Dermochelys coriacea	Endangered
Loggerhead sea turtle	Caretta caretta	Threatened
Sei Whale	Balaenoptera borealis	Endangered
Finback Whale	Balaenoptera musculus [1]	Endangered
Sperm Whale	Physter catodon	Endangered

SPECIES PROPOSED FOR LISTING

None

LISTED CRITICAL HABITAT

None

PROPOSED CRITICAL HABITAT

None

[1] The National Marine Fisheries Service appears to be in error in listing the Finback Whale by this name. The correct name for this species is Balaenoptera physalus.

If you have any questions, please contact Charles A. Oravetz, Fisheries Administrator, Southeast Regional Office, FTS 826-3366 or FTS 826-3720 or 813/893-3366 or 813/893-3720.

Sincerely yours,

for W. R. Ehlers
Harold B. Allen
Acting Regional Director

Enclosure

cc:
FWS, Atlanta, GA
FWS, Jackson, MS

APPENDIX I

US FISH AND WILDLIFE SERVICE

COORDINATION ACT REPORT

United States Department of the Interior

FISH AND WILDLIFE SERVICE

POST OFFICE BOX 4305
111 EAST MAIN STREET
LAFAYETTE, LOUISIANA 70502

January 13, 1982

General Thomas A. Sands, Reporting Officer
Atchafalaya Basin Project, Louisiana
Corps of Engineers
Department of the Army
P.O. Box 60267
New Orleans, Louisiana 70160

Dear General Sands:

The Final Feasibility Report/Phase I General Design Memorandum entitled "Atchafalaya Basin Floodway System, Louisiana" is being completed in response to three congressional resolutions and under the discretionary authority of the Secretary of the Army through the Chief of Engineers. The Feasibility studies were initiated by a United States Senate resolution in 1968 directing the U.S. Army Corps of Engineers (Corps) to review the Old River Control System and by United States House and Senate resolutions in 1972 directing the Corps to develop a plan for the preservation and management of the water and land resources of the Atchafalaya River Basin. The Phase I General Design Memorandum studies were initiated in 1976 to address alternative plans for accomplishing the authorized purposes of the Atchafalaya Basin Floodway project. Because of interrelationships between the studies authorized by the U.S. Congress and those authorized by the Chief of Engineers, they were combined into a single study.

Over the past decade, the Fish and Wildlife Service (FWS) has been afforded a unique opportunity to participate in front-end planning on the Atchafalaya Basin Project. The FWS has, to date, been involved in virtually every facet of project planning. We have monitored in excess of 20 biological studies within the project area and have drawn much of the data provided via these studies into two Planning Aid Reports, dated May 15, 1981, dealing with proposed water management and land use controls on the Atchafalaya Basin Floodway's fish and wildlife resources and with alternative solutions to providing flood protection to that portion of the study area below U.S. Highway 90 and east of the Atchafalaya Basin Floodway. As Department of the Interior representative on the Atchafalaya Basin Agency Management Group, the FWS has participated in the formulation and screening of alternative plans, in the selection of a tentative plan, and in the preparation of a draft environmental impact statement and feasibility report/ Phase I general design memorandum. By letter dated August 26, 1981, the Department of the Interior furnished a FWS critique of the tentatively selected plan and related implementation proposals for the project.

Confronted with an expedited reporting schedule, the Corps, on January 4, 1982, furnished the FWS with a section of the final report entitled "Assessment and Evaluation of Final Plans" requesting that we furnish final comments prior to January 15, 1982, the date on which the final report/environmental impact statement is due at the Lower Mississippi Valley Division. This letter report complies with that request and fulfills the FWS's responsibilities under provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

As in our earlier review of the tentatively selected plan, we have addressed the positive and negative attributes of the final recommended plan by project feature:

1. Distribution of Flows Through the Old River Control Structure

   Based on the recognition that stages within the Atchafalaya Basin Floodway will be dropping in the near future, due to center channel maturation, the FWS has in the past recommended flexibility in operation of the structure to allow an increase in flows into the Atchafalaya River, on an intermittent basis, to benefit aquatic resources. Conversely agricultural interests have requested a reduction in flows through the Old River Control Structure to allow for earlier planting in the Red River Backwater Area.

   We strongly support your conclusion that it would be virtually impossible to guarantee maintenance of a 70/30 flow distribution on an annual basis if flows through the structure were reduced during the months of May, June, and July, and we endorse your recommendation against such reductions of flow into the Atchafalaya River. Although we are discouraged by your determination that short term increases in flow through the structure are engineeringly unacceptable, we appreciate the need for caution in operation of the structure, particularly in view of its debilitated condition and the increasing probability of a change in course from the Mississippi River to the Atchafalaya River. Accordingly, we reluctantly support your conclusion that no short term changes in the authorized operation of the structure be recommended.

2. Training Works Along Main Channel and Outlets

We do not anticipate significant adverse environmental impacts from this action between River mile 53.0 and 116.0 if the channel training works are not constructed to an elevation which will confine greater than average annual flows. Similarly, we do not anticipate significant environmental damages from channel training works along the outlets if constructed as specified in the report. We caution, however, that continued support for this project feature could not be assumed if any future attempt is made to extend channel training works below the present mouths of the outlets (i.e. into Atchafalaya Bay).

3. Sediment Control

We endorse the concept of sediment reduction via realignment of principal distributaries in an effort to confine more sediment transport to the main Atchafalaya River. However, we must persist in our recommendation that the use of sediment traps, to remove sands and other heavy particulate matter from water entering through these distributaries, be more fully evaluated. To date, the only apparent criterion which has been used by the Corps in eliminating the latter alternative from further consideration is the "significant" land requirement (some 3,000 acres over project life) for use as spoil disposal areas. We continue to question whether the potential environmental damages of spoil disposal from maintenance of the sediment traps outweigh the sediment control benefits to be realized from this feature. We note a lack of data relative to beneficial environmental impacts that could be expected to result from the sediment-reduction contribution of these traps. In the absence of such data, upon which to base a "benefit versus cost" judgement, we believe that it is premature to eliminate sediment traps as a potentially viable and useful means of reducing sedimentation in the backswamps of the Floodway. If we assume that the combination of sediment traps and realignment of channel distributaries would remove 100 percent of the sands from the water entering through the distributaries into the backswamp during non-flood occurrences, the case for further examining the feasibility of implementing sediment traps is reinforced.

4. Increasing Flow Capacity of the Outlets

As we have indicated in the past, we are not particularly concerned with either maintaining the existing flow distribution or selecting the alternative of gradually limiting normal flows in Wax Lake Outlet (WLO) to 20 percent; however, we are firm in our belief that sediment flows through WLO should be maximized. We believe that this action would contribute to environmental quality by increasing the delta formation in Atchafalaya Bay. We are concerned that simply increasing flows (i.e., to 80 percent) through Lower Atchafalaya River (LAR), in the absence of WLO channel realignment to maximize sediment flow through this (WLO) outlet, would result in even a larger percentage of sediment being shunted via the LAR navigation channel through Atchafalaya Bay than is presently occurring. Recent studies indicate that construction and maintenance of the navigation channel through Atchafalaya Bay have severely restricted delta development below the LAR outlet and that future channel maintenance will continue to adversely impact delta development by allowing 25 percent or more of the delta-building sediments to be directed to deeper Gulf waters. We fully appreciate the need to maintain the navigation channel through the LAR and the Bay, however, we firmly believe that more efficient use of sediments for delta-building can be made by directing them through WLO. Certainly, we would not favor the elimination of delta development below the LAR, and we do not believe that this action would preclude this development. We do envision, however, that maintaining the navigation channel through Atchafalaya Bay will continue to aggravate delta formation in that region. You have indicated that, for engineering reasons increasing sediment through WLO could be accomplished only if a 70/30 flow distribution were maintained at the outlets. If this is in fact the case, we recommend that the ongoing delta sediment model studies and the upcoming delta management studies be completed prior to reducing flows through WLO. These studies will hopefully yield results which will allow the implementation of techniques to maximize delta development while allowing the Corps to manipulate the distribution of flows at the outlets to benefit flood control and navigation. Decreasing flows through WLO prior to completion of these studies might preclude future options for maximizing delta development.

Although there is no data available from which to quantify anticipated fish and wildlife resource impacts, the Corps' proposal to enlarge the overbank area adjacent to WLO to function as a "floodway" for the release of floodwaters from the Atchafalaya Basin Floodway may be environmentally beneficial. This feature will allow the nourishment of wetlands, which are presently severed from sheet flow by the existing levee on the west bank of WLO, with freshwater and sediment from the WLO. Further, diverting flood flows via this overbank area may accelerate delta formation in Atchafalaya Bay below the mouth of WLO. This appears, from an environmental standpoint, to be a technique for increasing natural delta development in the western segment of Atchafalaya Bay.

5. Reducing Backwater Flood Damages East of the Floodway

We view the recommended delay in implementation of any extension of the Avoca Island Levee as a step in the right direction and look forward to working closely with the Corps towards the completion of the necessary studies which will hopefully lead to a rational recommendation relative to providing flood protection to that portion of the project area east of the Atchafalaya Basin Floodway. We strongly encourage that these future studies consider the full gamut of interacting hydrological conditions and problems in this area.

Achievement of the very narrow and limited objective of reducing backwater flooding would in the long run give little security to the residents and industrial developments of the area east of the Floodway. By the end of the project life, flooding from other sources (e.g. headwater and tidal) will have rendered many of the existing developed areas uninhabitable. Thus far, alternatives (e.g. ring levees) for protecting the entire backwater area, or at least developed portions of that area, from all sources of flooding has never been given serious consideration since the Corps' existing authority would not allow resolution of other flooding problems.

Accordingly, we strongly support expansion of the Corps' existing authority to include resolution of all identified flooding problems in the area east of the Floodway. It is obvious from the Corps' recognition of the need for further studies in this area, that hydrological conditions have changed over the past 30 years, the period since the Avoca Island Levee was first recommended as the solution to this area's flooding problems. It is further obvious that a comprehensive solution to all flooding problems east of the Floodway is long overdue, and should be sought in lieu of a short-term solution to backwater flooding alone.

6. Water Management Concept for the Floodway

We essentially concur with the Corps' recommendations relative to implementation of two pilot management units and perhaps others in the future, depending on the effectiveness of the pilot units in accomplishing desired goals. It should be remembered, however, that the present design of management units is conceptual in nature and that the Corps should actually be requesting Congressional authority to do whatever can be reasonably done to mimic historical overflow patterns and to improve water circulation and quality throughout the entire Basin. Such actions might include immediate implementation of canal closures or circulation improvement features prior to total implementation of the water management program within any specific area of the Basin.

The water management units proposed will, at best, only retard the rapid degradation of the fish and wildlife resources, caused in part by past Corps activities in the Atchafalaya Basin. Present indications are that a gradual reduction in fish and wildlife resources, as compared to existing conditions, will still occur, even with water management units in place. At best, then, we can strive, through the management unit concept, to accomplish the formerly agreed-upon goal of maintaining, as nearly as possible, the 1972 environmental conditions in the Basin.

7. Land Use Controls Within the Floodway

We support the compromise real estate proposal announced by Governor David C. Treen on November 19, 1981, which provides for a tightening of the comprehensive habitat preservation easement to be acquired over privately-owned lands in the Floodway and donations and purchases from willing sellers of some 100,000 acres within the Floodway for public access. We do recognize, however, that the degree of public access provided for in that proposal does not fulfill the objective of maximizing public opportunity to observe and utilize the fish and wildlife resources of the Floodway. The proposal provides for no guarantee of access on overflow lands in the Floodway and provides for terrestrial access on less than 25 percent of the privately-owned lands of the Floodway. Access to overflow lands is assumed to be secure, based on the belief that a legal access right to these overflowed lands presently exists. This assumption is of concern to us, since the Louisiana State Attorney General has been asked to render a legal opinion on this issue and has thus far not done so.

8. Management Entity

We concur with the Corps' recommendation that recreation and environmental features of the plan be operated and maintained by appropriate Louisiana State agencies. We believe, however, that the Congressional Directives which mandated this study, by virtue of the fact that they call for the development of a comprehensive plan to preserve and manage water and land resources of the Atchafalaya Basin, including provisions to reduce sedimentation and improve water quality and commercial and sport fishing (i.e., management units), clearly intended for such activities to be treated as integral to the project and its operation. Accordingly, we believe that the Corps is obligated to adhere to the provisions of its own regulations

(ER 1105-2-129), which place the responsibility for operation and maintenance costs, particularly as related to water management units, which are integral to the project, with the Federal government. Governor Treen's real estate acquisition proposal does ask for such financial assistance as an integral part of the project. We support the appropriateness of that request.

We trust that we have been responsive to your needs and look forward to working with the New Orleans District on future studies related to this project.

Sincerely yours,

David M. Saileau, Acting for

Gary Hickman
Area Manager